THE INSTITUTION OF PRODUCTION ENGINEERS JOURNAL

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Vol. 32, No. 4 *Price 10/-* *April 1953*

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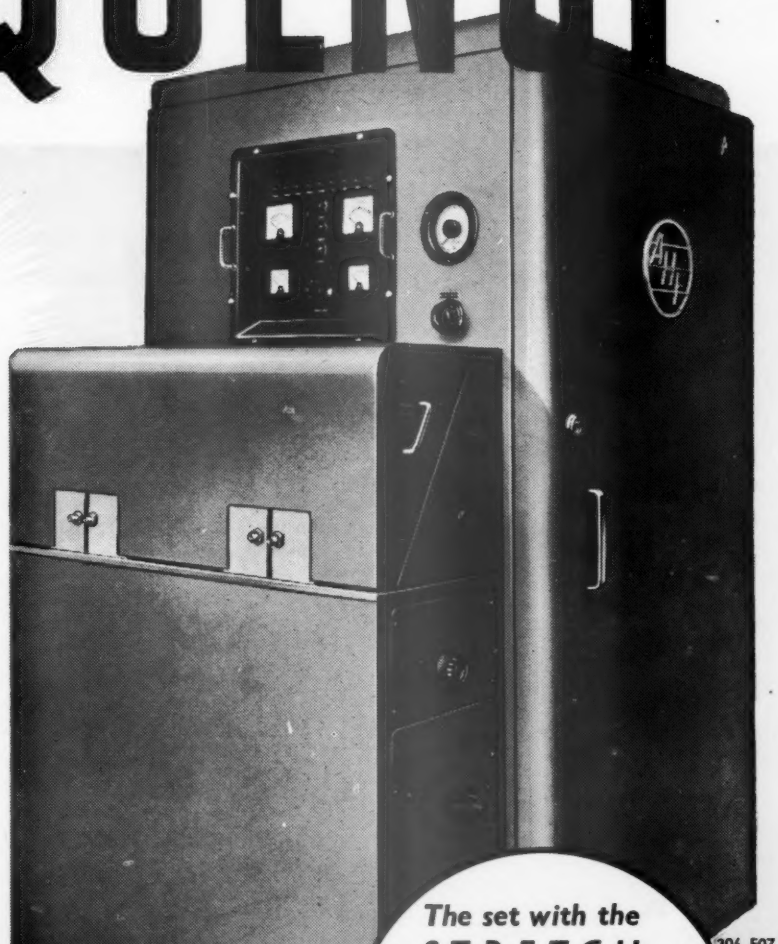

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The Institution of Production Engineers Journal
VOL. 32. NO. 4 APRIL, 1953

An Expansionist Policy for Production

by ALLAN ORMEROD, A.M.C.T., A.M.I.Mech.E., A.M.I.Prod.E.
Production Manager, Ashton Bros. & Co., Ltd.

The third contributor to this series of articles is a well-known personality in the textile industry. He presents some personal views on the most significant problems and factors involved in developing the effectiveness of the individual production unit.

THE two previous articles in this series have been concerned mainly with the social and economic aspects of production, with emphasis on the national problems of organising and motivating human and mechanical resources. This emphasis is justified as, in the limit, politico-economic factors provide the limiting framework within which the individual Production Manager or Production Engineer can manoeuvre. Efforts to implement an "expansionist policy for production" will be retarded —or even on occasion frustrated—by such factors as the limitation of capital development, the national shortage of trained and experienced Production Engineers, and the restrictive practices which militate against the full exploitation of the transfer of skill from operative to machine.

There are, nevertheless, wide differences in the effectiveness of individual units operating within the same constricting framework, which would appear to indicate that some degree of initiative is still available to those who are capable of using it. Indeed, there is evidence to suggest that much of the inertia and lack of co-operation in industry is self-imposed from within and not the result of external influences. It is intended in this short article to make brief reference to some of the aspects of production which have a cogent influence on productivity.

It is imperative that there should be wider applications of work study. I use the term "work study" in its widest possible usage, and embracing what is technically understood as motion study, time study, process study and operational research. There has been a tendency to Balkanise work study into its constituent parts and apply disproportionate effort to the constituents, paying greatest attention to time study in the belief that a rapid improvement in efficiency could be achieved with the expenditure of little technical effort. This may have been justified as a screening phase, preliminary to more fundamental investigations, but the general tendency to apply time study to inefficient systems is to be deprecated. The correlation of effort and remuneration is, of course, important. It is almost axiomatic that the industrial problems dealing with materials, machinery, and the physical side of industry are relatively important only as they bear on the greater problems of human existence and, for this reason, the rewarding of labour for services rendered is of very considerable importance. A work study, however, which achieves no more than a consistent 80 rate equivalent output from a unit has failed. The index of efficiency should be the ratio units of output per unit of work-input, the input figure being weighted by the appropriate equivalent units of work of the capital equipment used. This puts the emphasis where it belongs—on work methods and equipment.

This emphasis on methods should be projected backwards from the factories, to the work shops supplying them with capital equipment. The more fundamental type of motion study almost invariably exposes the large potential for improvement, subject to redesign of the equipment. It may be pertinent to point out that this should not be a manufacturer's responsibility. Machine designers should appreciate

that a manufacturer buys transferred skill and not merely a combination of kinematic pairs, and that machines can be ingenious without possessing commensurate manufacturing advantages over much simpler equipment.

The effect of the standard of mechanical maintenance on the work units necessary to produce unit product should also be appreciated. Good maintenance is not only essential to ensure a high sustained operating effectiveness, but is fundamental to any system of remuneration which associates payment with tangible performance. Time study without reasonably stable standards is useless, and "standards" imply a condition of mechanical stability which cannot be achieved by traditional methods of remedial maintenance. This is of particular significance in the textile industries. If a substantial machine variability effect is superimposed on the inherent variability associated with the natural raw materials being processed, it may be uneconomic to evaluate the standards essential to any system of payment by results. It is doubtful if work measurement can ever adequately keep pace with the sporadic effects of badly maintained equipment and, in any case, the expense involved in providing a continuous service for recording changing standards would be expected to exceed that involved in preventing them occurring.

The shortage of capital resources and the necessity to export mechanical equipment to other countries was stressed by Mr. Walter Puckey in a previous issue of the Institution's Journal 1. Under these circumstances, it becomes increasingly important carefully to evaluate plant and equipment prior to purchase. When a piece of capital equipment is purchased, two sets of conditions should be satisfied. The first is that the equipment represents the best investment which can be made relative to other possible purchases, and that the machine is the optimum type for the work which it is to perform, relative to other types in the same broad equipment group. The second is that the machine should be so staffed and integrated into the production sequence that the maximum advantage will be derived from its use. Failure to satisfy these conditions not only limits the purchasers' manufacturing effectiveness, but dissipates a constituent of the gross national product.

There can be few production decisions so important as the authorisation of purchase of new equipment. The profligate use of labour, high scrap rates, or ineffective maintenance can all be remedied when necessity makes such action essential, but capital expenditure commits an organisation to an annual charge for the life of the asset. A machine or piece of plant purchased as a result of an unsound appraisal is, therefore, a persistent drag on the overall effectiveness of the unit.

This leads on logically to the desirability of a high utilisation factor for capital equipment, and the question of shift working in British industry. Quite clearly the general change-over from single shift working to double-day shift working is undesirable. The results of such a change would be a reduction of some 16% in the gross national product and a commensurate increase of some 20% in cost/unit, even assuming additional premiums for double day-shift were not paid. In most cases, premiums of some sort would be demanded and the cost comparison would become even more unfavourable. The working of double shift must be settled on an individual basis and, not infrequently, on relatively small margins. It is not merely a question of working high capacity plant double shift. Of the 40,000 automatic looms in the cotton textile industry, almost 19,000 are working single shift. This is not merely a problem of staffing. With relatively small profit margins it pays to run pre-war automatic looms on single day shift, and only when cost is desensitised by large margins does it pay to change over to two-shift working.

Double-day shift working has a contribution to make to an expansionist policy for production, provided that it is only used where an intelligent appreciation shows it to be advantageous. Some of the circumstances under which this may apply are as follows :-

1. Where high-cost equipment is installed and a fairly rapid recovery of risk capital is essential.

2. Where margin conditions so desensitise the cost of manufacture of a product that profit tends to be proportional to output.

3. Where the demand for a certain product lapses and the labour can be switched to double shift operation on other machines which previously ran single shift on a product for which there is an unsatisfied demand.

1. February, 1953.

The Report of the Southern Section Conference on

"PROBLEMS OF AIRCRAFT PRODUCTION"

is concluded in this issue. The full Proceedings are being reprinted as a separate publication and copies may be ordered from The Secretary of the Institution, price 10/-, post free.

PROTOTYPE TO PRODUCTION

Report of Discussion following Session II

Chairman: S. P. WOODLEY, M.B.E.

MR. W. BROWNING (Director and General Manager, Saunders Roe, Ltd.), who opened the Discussion, expressed his appreciation of the excellent Papers which had been presented. The Conference was very fortunate in being able to hear the views of the authors, particularly today, when there was need to produce both civil and military aircraft in the right time and at the right price.

A good deal of attention had been focused recently on the time taken to build and the cost of building present-day aircraft, particularly in relation to the time taken before the War. While a good deal of the increase in cost resulted directly from the rise in wages of production and staff personnel, much of the increase in time and cost also resulted from the greater complexity and much increased structural efficiency of the modern aeroplane. These two points alone provided very good reasons for setting up sound engineering control systems, quite apart from the fact that it was impossible to produce many hundreds of thousands of parts in the right place at the right time without a system of some sort—the better the system, the better the results.

Mr. Fielding and Mr. Povey both called attention to the main problems. The former had provided plenty of ammunition for the discussion by going into great detail to show exactly how he controlled his own factory. Mr. Browning found it difficult to criticise the methods employed there, since he had adopted them himself during the War. There were, however, a few points which he would like to make.

Firstly, he could not over-emphasise the importance of having qualified Production Engineers in the Design Office, not only when the production version was being drawn, but also when the prototype was being designed, as by so doing, the difference between the two could be kept to a minimum and many of the temporary prototype tools could be used to assist with the early production aeroplanes.

Secondly, he considered it desirable that the engineering department should be located as closely as possible to the Design Office, and the other side of the control system, that was, production control, as closely as possible to the shops. If all four could be close together, so much the better.

Thirdly, he was of the opinion that it would be helpful if far more lofted plates were issued than at present. He saw no reason why many more details should not be initially drawn in this way, as this would help with making small tools. The engineering department, however, should be the deciding factor in this matter.

Fourthly, he thought that there was a tendency to machine too many intricate fittings out of the solid. This should be avoided at all costs, as almost every machine shop in the country was very much overloaded. That would have its effect on forging and stamping capacity, but this was something to which the material producers themselves would have to pay attention.

His last point on Mr. Fielding's Paper was, perhaps, a somewhat pedantic one. He had used Mr. Fielding's system, and found that it was not always advisable to put the Week Numbers on the Job Cards. When an alteration to a programme took place, as did happen, modification of individual cards involved quite a large amount of work. His own people put a simple code number on the cards, and issued the shop supervision with a chart correlating those code numbers with the production programme.

MR. S. SCOTT HALL (Director General, Technical Development (Air), Ministry of Supply), said that what had struck him very forcibly about the earlier Discussion was that there seemed to be two sets of people talking, the designers on the one hand and the production people on the other. He thought that, in the year 1952, that was an extraordinary situation. It might have been appropriate in the very early days of aviation, when to produce a single machine which would fly was very wonderful, but at the present time, when they were trying to produce aircraft which they could sell abroad or supply to the Royal Air Force and the Royal Navy, it seemed to be a wrong conception. He would like to see some re-orientation of outlook, whereby the objective would be the production of a large number of articles from the start, and not a prototype on the one hand and production on the other.

MR. H. POVEY said that the problem was a difficult one, and possibly the customer could do more to solve it than the industry. The Ministry, within limitations, knew their requirements and could probably arrange to give orders for quantities instead of prototypes only.

Mr. Scott Hall had said that there seemed to be two groups of people speaking, presumably in different and possibly diametrically opposed terms. The same pattern of debate could be heard in Parliament on almost every subject, and personally he thought that debates of a constructive nature were always extremely healthy.

MR. SCOTT HALL intervened to say that his point was that it was not clear to him, from what he had heard, that the designers and Production Engineers in any one industrial organisation formed one team for which there was a single leader.

MR. POVEY felt that the industry was relatively still in its infancy. When those concerned were called upon to produce and develop the complicated types of aircraft which were being designed today, they knew that, both in this country and others, they were really only at the beginning of "the shape of things to come".

The complexity of the modern high speed aircraft did not enable them to run before they could walk. Some day, aeronautical design and data might be such that it could be taken from the text-book and data sheets to the same extent as applied to shipbuilding and other stabilised industries, but he was afraid that this would not be achieved in his time.

He felt that the advance which had been made in the design of aircraft in recent years had brought about so much complication that the aeroplane was still a baby which had to be nursed. Therefore, it was still not possible to produce modern aircraft in the same way as motor cars or traction engines.

MR. SCOTT HALL replied that he appreciated the difficulties to which Mr. Povey had referred, but he thought they were rather beside the point he was trying to make. In any case, he thought that Mr. Povey and his colleagues had gone as far as any group to create the situation which he (Mr. Scott Hall) thought was so essential.

In reply to Mr. C. E. Fielding, MR. SCOTT HALL said that it was to the lack of co-operation between the Design Office and production that he referred, but it was more than that. The point was that they did not exist to produce prototypes. It had always seemed to him, perhaps because he had always been concerned with development, that the highlight of the aeronautical world had been to produce a prototype, which was then put into production. He suggested that was a wrong outlook. They ought to aim from the start at producing numbers of aeroplanes.

MR. POVEY replied that it had always been his Company's policy to produce numbers of aircraft in parallel with the prototype. They had always pressed the Ministry to order on this principle.

Referring to Mr. Scott Hall's point concerning leadership, Mr. Povey would like to give him some assurance that such persons existed and did give direction, by quoting a factual example, concerning a small trainer aeroplane, the Chipmunk. He pointed out that there had been a lot of competition and excitement between his Company and another to obtain the order for this aircraft, and his Company went ahead with a heavy programme of tooling before obtaining the order, or even receiving an I.T.P. When they were two-thirds of the way through the tooling production programme, they were told by the Ministry of Supply that it was very little use proceeding with the project, and advised that it would be in their own interest to stop all work.

The "man in the middle" (the Managing Director) just said "Carry on". They did so, and spent about £350,000 on tools. Finally, they received the order, and to date had kept their programmes. Here was an example that there were people who could give direction, make decisions and take risks.

MR. FIELDING commented that Mr. Scott Hall had apparently got the wrong impression from the Discussion which took place at the earlier Session. In his factory, the liaison between design and production was excellent. It started at the very conception of the design and continued right through the life of the type, on every level. Most problems could be satisfactorily dealt with in this way and many ended in a compromise, but cases requiring policy decisions were quickly dealt with by the Managing Director.

Regarding the question of producing numbers of aeroplanes rather than a prototype, he supported Mr. Povey's contention that this was mainly a question of getting the necessary contracts. Mr. Fielding's firm always had production in mind when designing and building a prototype, and this was reflected in their tooling policy, which gave them a good start when production orders were received.

MR. D. GAMMELL (Engineer T.G.I, Ministry of Supply) observed that in all fairness to the Ministry, it should be borne in mind that they had to satisfy a "managing director" who was a politician. He was the head of the Department, and as a politician he had to satisfy Parliament, so that there were bound to be variations according to the vagaries of the political programme.

Air Commodore G. SILYN ROBERTS (Director (R.A.F.), Military Aircraft Research and Development, Ministry of Supply), speaking as a Royal Air Force officer, observed that it was not entirely the fault of the Ministry of Supply, if indeed there was a fault anywhere. The Air Ministry authorised orders for production aircraft in quantity, and it was a little different from ordering a relatively conventional civil air liner. If one started to build a really advanced type, having perhaps a delta plan-form, which had never flown before, it was natural that the Air Ministry should be very careful about committing themselves to production, and they liked to have a reasonable assurance that what was ultimately produced was not what the Americans called "a clunker".

MR. R. E. MILLS (Senior Designer, Bristol Aeroplane Co. Ltd.), said that as a member of the Standards Committee of the Institution of Production Engineers he had been very pleased to hear, and heartily endorsed, Mr. Fielding's remarks about standardisation in tooling. He would like to suggest that it was desirable to go even further than that; he would like to see more standardisation in drawing the tools. Draughtsmanship was a very expensive operation, and it was desirable to have more in the way of standard printed layouts for capstan set-ups, cam set-ups and the like. He would also suggest a certain measure of standardisation in processes, and so on.

MR. FIELDING stated that in addition to the examples given in his Paper, his Company had many other Standard Data Sheets which reduced jig and tool design down to a minimum. There were also Standard Processes for the manufacture of those tools so that all that was necessary to get a tool in production was to add information relative to the particular tool required.

MR. A. I. MORGAN (Technical Officer (Engineering)), said that it had sometimes occurred to him, particularly where the aircraft industry could get a model accepted for a long run, that something might be learned from the old German "doodle-bug". It was a very well designed, high wing loaded and very fast machine, with quite a considerable pay load. If one closely examined some of the details of mass production in that machine, one realised that a considerable amount of ingenuity had been displayed in cheapening its production and cutting out luxuries and elaborate machining. He had often wondered whether, when the quantities justified it, those principles could be adopted and some of the refinements of modern aircraft forgotten.

MR. D. G. HITCHCOCK (Directorate of Aircraft Production Services, Ministry of Supply), remarked that Mr. Fielding said in his Paper that "The contract, besides giving the quantity, includes the delivery programme", and then went on to include in his Group 3 "Prepare target programmes". That seemed to be the wrong way round, and Mr. Fielding's target programme was that information which gave the correct delivery programme.

MR. FIELDING replied that he had quoted from an actual example on a contract which his firm had received a year or two ago. This example was used to illustrate a method which would establish several basic factors affecting the aircraft programme, the principal ones being when the tools and material would be required.

In the particular case used, the programme given was found to be satisfactory and was, therefore, accepted, but if it had been found that the tools could not be made in time, or the material obtained when required, then a revised programme would have been requested. If Mr. Fielding's Company had not been given a delivery programme, the investigation carried out would have been exactly the same. The same kind of target programme would have been used. He thought this explanation should clear away any misapprehensions.

MR. S. R. RUDGE (Executive Production Engineer, de Havilland Aircraft Co. Ltd), asked whether Mr. Fielding's Company had experienced any trouble due to the Design Office or the Drawing Office deciding the material required, and putting their schedule on the drawings. On quite a number of drop hammer pressings, the size of material

required could not be decided from the drawing, as it rather depended on the design of the tool, which might have one or more draw beads, for which extra material would have to be allowed. Likewise, on stretcher pressings, it depended on the shape of the details as to the amount of waste material to be allowed for pull-off. Also, certain jobs in the Machine Shop must have allowance for chucking, and possibly test pieces.

There were also jobs which could not be centreless ground in which case allowance would be made to have centres, which would be removed after grinding.

Mr. Rudge also asked whether the Drawing Office decided what they thought would be required, and if it was then modified by the Production Engineer ?

MR. FIELDING agreed that it was not practical for the Schedule Clerks to establish material quantities to cover every single item, but the vast majority could be covered in this way. It was necessary for the Process Engineers to advise the Schedule Clerks on chucking allowances, material required for drop hammer parts, stretch-formed items, fuselage formers where nesting was required in order to economise on material, etc. In all such cases, this information was put on the Drawing Office Schedule as soon as it could be ascertained.

MR. MARK H. TAYLOR (Managing Director, Taylor, Taylor & Hobson, Ltd.), referring to the series of photostat copies of "Optical Tooling" which had been distributed, said that he rose with some trepidation, because he knew very little about the detail problems of aircraft production. He asked the question: "Were we in this country failing to make use of optical tooling to the extent that we should ?"

He referred to page 12 of the booklet, which had recently been issued by the American Government. The history of this optical tooling was interesting. It started in the United Kingdom, as so many things had done, with a request from one of the aircraft firms for an instrument to be made for the optical tooling and aligning of jigs. That was in 1937, and it was only as a result of that experience in Britain that the Americans learned of it. The first thing they did was to issue a Development Contract to study the whole matter, as a result of which they came to the conclusion that they could save 20 per cent. of the time on the alignment of many of the jigs and, in one case, as much as 60 per cent. Subsequent experience in quite a number of American aircraft companies had confirmed that view.

The Americans were now using this technique very extensively, and Mr. Taylor wondered whether the industry in this country was failing to make use of something which it ought to be applying to a much greater extent.

He had certain figures which might be of interest. Since 1944, 16 instruments had gone into the industry of this country and, in the corresponding period, nearly 330 to America. At the present time the English demand was two, and the American 70. He pointed out that he did not put the question because his industry was short of orders at this time, but because he was worried whether it was an example of where this country was failing to use a technique which would help it to compete in the manufacture of aircraft.

MR. FIELDING stated that his Company was the one which had made the request to Taylor, Taylor & Hobson for an instrument for optical tooling and aligning of jigs, and had used it extensively ever since. He considered it an essential requirement, particularly on large assembly fixtures.

MR. POVEY said that his Company also used the technique, but whether to the full extent he would not like to say. They had used it for six or seven years. If Mr. Taylor had supplied 16 in England against 300 in America, that would seem to be about the right ratio. If, at present, there were applications for two as against 70, perhaps Mr. Taylor's Company's propaganda was not good enough. Possibly some aircraft manufacturers did not know about the method. Mr. Povey's Company would not know what to do without it—it was extremely useful and they employed it all the time.

BETWEEN SESSIONS

(Left to right) Mr. W. S. Hollyhock (Chief Production Draughtsman, Hawker Aircraft, Ltd.); Mr. H. W. Sidwell (Director, Aircraft Division, Air Service Training); Mr. H. W. Denny (General Production Manager, de Havilland Aircraft Co.). and Mr. J. B. Turner (Works Manager, Air Service Training). Both Mr. Denny and Mr. Turner are members of the Southern Section Committee.

MR. TAYLOR expressed his gratitude to Mr. Povey for giving him the answer to his question.

MR. T. B. WORTH (Education Officer, Institution of Production Engineers) said it was estimated that the United Kingdom was training seven "designers" for every Production Engineer. Over the last five years, the facilities for the education and training of Production Engineers had expanded by over 100 per cent., but the use of these facilities had increased by only about 20 per cent. In his investigations into this question, particularly in the South, where there were aircraft firms, he found that the provision made had not, in the past, been fully used. With one or two exceptions, that was the general state of affairs throughout the country.

The de Havilland Company was one of those which did use the facilities available for education and training in production engineering. He would like to know whether Mr. Povey felt that what was being provided was right in quality and quantity, and whether the fact that Mr. Povey's Company had adopted the policy of training a large number of young Production Engineers had had an effect within that organisation.

On the question of liaison between design and production, when the type of training to which he referred first started, there had been two streams—design and production. They still existed, but one of the latest developments had been the provision of courses in both universities and technical colleges, whereby students could obtain a "design" training and, after a period of further experience in the works, go back for a course in production engineering. It seemed to him that was what the Conference had asked for—men with the design and production points of view.

The position caused him some anxiety. The aircraft industry wanted Production Engineers, but in general it was not using to the full the facilities available for providing them. He suggested that should be corrected, particularly in view of the trend to which Professor Richards had referred earlier of a number of young engineers in the industry going abroad.

MR. POVEY said that Mr. Worth had raised an extremely important point, perhaps of greater importance than was generally realised. He felt that many young men were not paying sufficient regard to the future.

From early in the de Havilland Company's expansion, it was found essential to commence technical education with a view to recruiting personnel for their own requirements. They now had approximately 1,200 students under training in various branches of the industry, including design and production. The education of Production Engineers had to be fostered and no time should be lost in encouraging this step forward. If the industry was to survive and keep its place at the top, it must have well-qualified engineers with good training, and initiative.

With regard to production engineering, it seemed that the young men did not want to enter this section, and more frequently favoured design. The industry should attempt to solve this problem, but how to do it Mr. Povey did not know.

During the past twelve months, he had toured many parts of the country and had visited many Companies, and on every occasion he had made it one of his duties to try and arouse the enthusiasm of the young men for production engineering. He had asked them to realise that the industry, in the very near future, depended to a great extent on their initiative and ability.

His Company gave every encouragement to candidates to enter this field. In addition to the standard syllabus, they offered a number of post-graduate courses which could be taken up after students had returned from university training. He thought that if the aircraft industry in this country was to survive on a healthy basis and hold its place with industries abroad, it was more than ever essential that full advantage should be taken of the facilities which were now being offered in the universities, colleges and institutions. He supported all that Mr. Worth was doing and wished him every success.

MR. FIELDING said that he fully endorsed all that had been said on this subject. In addition to his Company's Training School, which looked after apprentices up to 21 years of age, they had a Scheme which continued training of selected personnel beyond this age. This Scheme gave them the necessary experience to qualify them for executive positions.

WING-COMMANDER L. P. GIBSON (Air Ministry), asked whether in any future War there would be enough pairs of hands to make all the aircraft required, bearing in mind their ever-increasing weight and complexity. He had heard that it would take six times as many pairs of hands to make a Hunter as it had taken to make a Hurricane in 1940.

MR. FIELDING replied that if the industry were given the orders, he was sure that they would be able to carry them out as they had done in the last War. By suitable tooling, the manhours could be reduced considerably and the percentage of skilled labour kept down to a minimum.

During the last War, his Company's percentage of skilled labour was 12% and even some of these had been upgraded. A large percentage of the semi-skilled labour could be female. It was obvious that the types now being built were more complicated and would demand more manpower for the same number of aircraft, but even this could be kept down to a minimum if sufficiently large orders were placed.

A MEMBER, referring to the time taken to get the prototype and the first production 'Comet' through, asked whether the de Havilland Company had found it necessary to cut across their existing system in order to achieve what was relatively a short time.

MR. POVEY replied that his Production Engineers had taken full advantage of every short cut known. The ideal production system was that which had been described by Mr. Fielding. He would have liked their designers to listen to Mr. Fielding's Paper, because they would have realised that their outlook on design in relation to Production Engineering would have to undergo many changes if his Company had to work to it at the start of a project such as the 'Comet'. In fact, when judged in relation to the methodical system described by Mr. Fielding, it could be said that Mr. Povey's Company had relatively just muddled through on the 'Comet'. It had entailed a great deal of extremely hard work and direction from all executives. For a long production run, the ideal system was that described by Mr. Fielding. The de Havilland Company worked on somewhat similar lines, but always found that they had to admit a great amount of flexibility to achieve their objectives.

At the start of the 'Comet' project, they realised that unless they got the aircraft into the air quickly and successfully, the money allocated for the job would be absorbed and eventually regarded as lost. It was therefore true that to achieve what they had done, they had really cut across every existing system with a view to saving time.

From the beginning the production team had formed part of the design team at the design production meetings. Much valuable time had been saved by healthy discussion with the design section and, in many ways, the designers had met production requirements in a most agreeable manner and to great advantage.

MR. J. MCCULLOCH (Technical Liaison Engineer, A. V. Roe & Co., Canada Ltd.) said that the answer to Mr. Scott Hall's question about the production side being quite distinct from the design side had been given by Mr. Povey, when he said that several Production Engineers had been allocated to various sections of the Design Office.

Personally, he thought that insufficient emphasis had been put on that, and that in various firms which he had visited, much more could be done in that way. In other words, the training for production and the experience required took up a considerable number of years, in the same way as did training for design, so that one could not

expect anybody to take both courses. It seemed to him that to put trained Production Engineers in the Design Office, to guide what was being done from the early stages, would go a long way to doing what was required and to providing proper liaison between the two departments.

MR. POVEY said that the scheme was excellent but, as a word of caution to anyone who was about to introduce it, he would say that success depended on the selection of the engineer, who must have a sound practical training, together with some technical experience, and a personality suitable to the job. Without these attributes, he might become 'blinded by science' and the whole scheme would fail. If, on the other hand, the selection was a success, the engineer would soon become a pillar of the Drawing Office. The designers soon appreciated the assistance the right man could give them. Apart from giving direct advice on the drawing board, the engineer would frequently arrange for the tryout of new techniques in the shops, with a view to enabling definite conclusions to be arrived at before the designs of unestablished techniques were issued.

MR. B. G. L. JACKMAN (Works Director, British Heat Resisting Glass Co. Ltd.), asked Mr. Povey whether with his concrete tools the concrete was in the as-cast condition, or whether the surface was treated with bitumen or wax. Further, when temporary tools were made for the first 5/10 sets, he asked whether there was not a big temptation to use them for 100/200 sets, and whether the tools made would stand up to 200 sets.

MR. POVEY, replying to the first question, said that the tools were made of a standard concrete mix and were moulded in a plaster mould. On removing, they contained slight defects, principally cavities, caused by air bubbles which had been trapped in the mould. The surface of the concrete tools was fettled with a rotary abrasive disc, after which they were given a coat of primer and a finishing coat of Phenoglaze. This was a resinous compound which provided a hard, tough skin, with a high-class finish, and provided a very good surface for stretcher press work.

On the second question, Mr. Jackman was quite correct; Mr. Povey had found that whenever temporary tools were made for a limited number of parts, these tools normally stopped in production for a considerable time and it was frequently quite difficult to get them away from the operators. If, however, the tools kept on doing their job, there seemed to be no objection to leaving them in production, unless a considerable saving in cost of production could be affected.

THE IMPACT OF MODIFICATIONS ON PRODUCTION

PART 1

by T. GILBERTSON, M.I.Prod.E.

Mr. Gilbertson served his apprenticeship at Vickers, Ltd., Barrow, and after gaining experience with Vickers (Erith) Ltd., and John I. Thornycroft, Ltd., he joined Supermarine Aviation Works at Southampton. Later, he moved to Airspeed, Ltd.

In 1936 he was appointed Assistant Works Manager to Folland Aircraft, Ltd., becoming successively Works Manager, then General Manager. He was elected to the Board in 1945.

Mr. T. Gilbertson

BEFORE discussing the impact of modifications on production, I shall give a brief outline of the procedure leading up to the introduction into the production shop. The L.T.C. (Local Technical Committee) study the modification and recommend a classification, using the Ministry of Supply procedure which embraces: (a) Contractor application; (b) Service application.

This procedure can be grouped as follows:

(i) degree of urgency of embodiment;
(ii) conditions in which embodiment is to be effected;
(iii) persons or institutions responsible for ensuring embodiment.

These three aspects are not naturally coincident. Hence, classification systems have either been over-complex or have had to be used in a flexible and "coarse-meshed" manner.

Further grading for classification involves four principal assessments:

(i) the operational and/or technical value of the modification;
(ii) the practicability of embodiment at contractor's works;
(iii) the practicability of embodiment during service maintenance; and
(iv) time of availability.

In considering (i) and (ii), regard has to be paid to the practical means available for doing the work and to the currently-available capacity of these means.

Definition of Modifications

The result is a modification and is defined under one of the following classes:

M.o.S. Classification

(AA) Essential before release to service. Delay and scrap allowed.
(A) Imperative.
(B) As soon as possible—with scrap.
(C) As soon as possible—without scrap.
(D) When convenient.

L.T.C. recommendations are studied by the A.M.C. (Airframe Modification Committee). The A.M.C. and other associated Modification Committees are Ministry bodies and they approve and confirm L.T.C. recommendations, subject to trial installation where warranted. That is a brief outline of the procedure, and Mr. Howat can give you more information on that subject.

We have very briefly covered all stages up to receipt of information by production departments. Production departments, through their Modification Committees, arrange for embodiment from tools at a definite machine set, and in the interim period every effort is made to catch up on work-in-progress as a retrospective action subject to material availability.

Urgent modifications are frequently put into effect by freehand work and temporary tooling methods. This calls for the employment of a high percentage of skilled labour; in the absence of a pool of such labour, this will need to be drawn from several jobs or shops to avoid a set-back in any particular department.

Effect of Modifications

The modification impact on final assembly of aircraft can be said to affect:

(i) airframe components;
(ii) engines; and
(iii) equipment.

Equipment which has an ever-changing nature can be said to affect the production of components. The consequential effect of modifications to equipment can be quite serious and far-reaching. Delay in making the decision for an installation of new equipment often seriously affects delivery schedules of aircraft. Engines, which may be considered fairly stable, can be said to have little modification effect on components. Components themselves can be said, therefore, to give most trouble to production.

Component modifications can be segregated as follows:

(i) structural;
(ii) functional;
(iii) maintenance.

Large numbers of modifications are structural.

The preparation for the embodiment of a modification and the co-ordination of other modifications running concurrently impose a severe load on the production planning departments, much more so than on the shop floor where the "bits" are made and fitted. On frequent occasions, up to 50 per cent. of works staff time and 25 per cent. of tooling capacity is taken up by modification impact, in order that there be no hitch in production. To achieve this, much paper work is necessary, such as:

1. Modification Summary.
2. Modification Meeting Agenda.
3. Modification Meeting Minutes.
4. Planning Schedule Amendments, etc.
5. Process Sheet Revision.
6. Tool Drawing Modifications.
7. Resultant Cost Adjustment, Data in Estimating and Rate Fixing Department.

Incorporation of Amendments

Besides the modifications which are covered by a definite modification number applicable to mark of aircraft, there are also hosts of amendments to drawings which cover minor alterations, or improvements or alternative methods to achieve the main modification. All amendments must be dealt with through the works procedure described. Amendments do not necessarily involve the raising of the Drawing Issue Number, and this constitutes an added complication, necessitating correction and concise transfer of information to shop floor. Again, there are other sources of modification necessitating immediate retrospective action on the shop floor for a Class II modification pending, which will be covered by a raised issue drawing later.

Although modifications are accepted by production departments in the right spirit, there is the need for management to give serious attention to their proper and economical introduction. This can be achieved by insisting that planning departments deal with the modifications quickly and effectively at meetings which should be held at regular intervals.

Liaison with Design Office

It is essential for Design Office personnel to keep right up-to-date with the latest methods of production and the facilities offered by new machine tools which may have been introduced into the works. Planned visits to other factories and Service establishments would be beneficial. Mutual understanding between Works and Drawing Office is important if needless modifications are to be avoided.

It is recommended that Methods Engineers work in close liaison with the Design Office right from the start of any project. This includes experimental aircraft.

When making decisions to build a new aircraft, management must give equal importance to organising the resources necessary to incorporate modifications right from the commencement. Production space, equipment and manpower must be available to avoid building up a back-log of out-of-date components.

It is considered that a survey would show that control surfaces are most susceptible to modifications. This being the case, production planning should see that minimum quantities, consistent with production line requirements only, are put into production until the aircraft has proved its merit in service. Early demands for spares often upset this arrangement. Pre-production tooling would probably meet the case here.

When modifications reach large proportions, it is often suggested that a separate department should be set up to deal with them, but it is our opinion that it is better to have modification specialists working in close harmony with the production planning and shops.

Production Engineers must not shirk responsibilities to incorporate safety modifications at the earliest opportunity. They should also endeavour to the utmost to assist the designer to enable him to produce better aeroplanes by energetically tackling important changes in design. The Spitfire is an obvious example of teamwork between Drawing Office and production. The Comet and Canberra are two later examples.

Importance of Estimating

A reasonably accurate estimate and survey of a modification is necessary for discussion at the initial stage at the Works Modification Meeting. The survey should take into consideration the state of production assembly lines, and also the detail and sub-assembly position. Independent learning curves should be generated wherever possible, to give an assessment of the impact of the modification on the rest of the machine or component. Learning ability on assembly of all parts of a wing structure is fairly consistent, but the rhythm or learning curve is completely upset when a major modification is introduced. To take a typical case, when wings have reached planned production rate, a new aileron may be required. The conditions for producing the new aileron are at "scratch". In an attempt to catch up with the production rate, the ailerons are manned up regardless of cost, with the consequence that a reliable date is unobtainable from Job Cards. That is still worthwhile, and "regardless of cost" does not condemn what is done.

In conclusion, the object of this Paper is to provide an opportunity for those present to enter into a discussion on the subject. A free interchange of ideas, rather than questions, will make a better contribution.

THE IMPACT OF MODIFICATIONS ON PRODUCTION

PART 2

by H. S. HOWAT, B.Sc., A.F.R.Ae.S.

Mr. H. S. Howat

After early training at Barclay Curle & Co., Glasgow; Sir W. G. Armstrong Whitworth Co., Coventry; and Vickers Supermarine Works, Southampton, Mr. Howat joined the Air Ministry in 1936.

He served with the Ministry of Aircraft Production and the Ministry of Supply on Research and Development Branches at R.A.E. and H.Q., and was a member of the British Air Commission in the U.S.A.

He is now Assistant Director, Aircraft Production, Ministry of Supply.

A FEW years ago the cost of airframe and engine modifications for Service aircraft was estimated at £M6½ per annum. I have mentioned this to show the size of the problem and to indicate the amount of manpower tied up in this work.

The reason for this large expenditure of effort may be found by investigating why modifications arise.

An examination of records shows that defects and potential defects are the largest single source of airframe modifications. These arise not only from errors and omissions in the original design, but also from the operators' use and misuse of the aircraft. Although the numbers of modifications may be large, the effort required for rectification in production in terms of manhours is usually only about 20 per cent. of the total modification load.

On the other hand, new requirements by the operators, although only about 15 per cent. in numbers, generally account for about half of the total effort in production. This large effort for new requirements is in the main due to the limitation of space in modern aircraft, where the introduction or repositioning of one piece of equipment may involve the reshuffling of several other items, in addition to the supply of new parts. A smaller effort is required for defect rectification and design improvements, since in most instances very little additional work is required to make the new parts than was necessary for the old parts.

This pattern is quite general, namely, a large number of simple modifications to rectify or improve the design and a small number of operators' requirements, which are relatively expensive in time and labour on the production line.

Are Modifications Necessary ?

Are the modifications which arise from these two sources really necessary ?

Since it usually takes more than five years to design, manufacture and clear an aircraft for service use, the customer and the designer will, in the meantime, have developed more advanced ideas and even some new equipment, which could not be incorporated in the original design without causing further delay. It is therefore advisable to go into production as soon as possible before the original design is out of date, and to bring in the necessary improvements during production.

On the other hand, defects and potential defects are mostly discovered after the prototype has flown, and often much later under actual service conditions. It is, therefore, also necessary to introduce modifications from this source during production, the incidence of such modifications being greater when production has started before the prototype has been fully tested. A modification system is, therefore, essential and by giving us a rapid means of improving our aircraft, also provides the opportunity of maintaining some measure of superiority over our competitors and opponents. It may also be used to prolong the life of the type and where new variants are required, lead to additional quantities being made with obvious production advantages.

The existing procedure is such that no modification is allowed to delay delivery unless the aircraft is otherwise unacceptable to the Service. Such modifications are not numerous and generally only occur prior to the introduction of a new type. All other modifications are allowed to flow into the production line without affecting the rate of output. The modification procedure has thus been designed to have the minimum adverse effect on production. Let us now examine this in greater detail.

Production Line

An examination of the increased production costs due to modifications, when compared with complete aircraft, indicates that the additional effort required each year is about 1 per cent. of the total. Generally speaking, once the modification has been introduced the effect on production is small. This comparison, however, does not take into account the slowing-down effect of introducing an unfamiliar item. If production is flowing steadily it will, of course, refuse to be slowed down, so that it is usually necessary to provide additional skilled labour to make and fit the new parts in the initial stages so as to facilitate the introduction of the modification. This may involve the added expense of a quantity of hand-made parts and requires good organisation when dealing with high production rates, so as to avoid intermittent incorporation. The main difficulty on the production line is, therefore, one of organisation to meet the target point of entry at the right speed.

Tooling

Since most tools, apart from main assembly jigs, are not in continuous use, they can be modified when convenient without detriment to production. In cases of urgency it may, of course, be necessary to provide temporary tools while more permanent tools are being made. The customer usually accepts the additional expense involved where he will be better off by having fewer aircraft to be modified after delivery.

In order to avoid unnecessary tooling changes in the early production of new types, the build-up of tools should be carefully planned in conjunction with the designers, who may be aware of impending changes in cases where some relatively major aspects of the design have not yet been cleared.

Modification Parts

In large scale production, the supply of modification parts for retrospective application may account for 50 per cent. of the total modification effort. Its main influence is that it absorbs labour which could be otherwise employed to increase production. This reduction in possible output is the price we have to pay for the improvements we derive from modifications. The greatest demand for modification parts is, however, after a large number, or possibly all, of the aircraft have been delivered, and may come at a time when surplus labour is becoming available. In wartime this problem is not so acute, due to the high wastage and in any case there is usually little opportunity to ground the aircraft in order to do the work.

Embodiment by Working Parties

At the present time, contractors' working parties are incorporating modifications in military aircraft already delivered at the same rate in manhours as the whole of the Air Force. This ties up a large number of skilled men who could otherwise be employed on production within the factories. This arrangement is most uneconomical and is only justified where the Service would find it impossible to do the work themselves.

Scrap

Scrap is allowed for modifications urgently required, and the additional expense is usually balanced by a reduction in the amount of retrospective work. The cost involved will depend on the quantity of parts already made. A spot check on one type revealed that the value of one aircraft in 300 was lost in scrap. This wasted effort is another contribution to the price we have to pay for the urgency of our requirements.

Large Modifications

Occasionally, large modifications which cannot be quickly introduced in production are found to be necessary. In such cases the aircraft can be returned to the contractor after delivery for modification. The main effect on production is, of course, the additional labour and space which must be given up for this work.

For still larger modifications, a new mark of aircraft may be introduced and a separate production programme agreed. One firm which produced a new mark of an existing type each year, for several years, estimated that on the introduction of the new mark, the manhours to produce the whole aircraft were increased by 10 per cent.

I should now like to mention a few of the methods which have been tried in order to reduce the difficulties of dealing with modifications.

Batching of Modifications

An attempt was made during the last War to follow the American practice of introducing batches of modifications at intervals on the production line, i.e. at every 50th or 60th aircraft. This was not successful, since important and urgent modifications were sometimes delayed to a later series, thus causing the Service a greater load of work after delivery. This system is not likely to be successful where there is uncertainty regarding supplies of the materials, equipment, etc., required for the modification, and may well increase the production difficulties rather than diminish them.

Modification Centres

In order to avoid interfering with the production line, modification centres have been used for the conversion of a batch of aircraft to a special role. For example, during the last War, in U.S.A., all aircraft diverted to us were at one time passed through modification centres to have provision made for British equipment, etc., before delivery to this country. This is a costly business, as it invariably involves scrapping parts or undoing work already done on the production line. It could, however, be used for incorporating the less urgent modifications which were not available at the time of construction. This problem is being studied at present, but one of the main difficulties is that the return of aircraft to a modification centre may interfere with the functioning of the Service, who would then have to operate with a reduced number of aircraft. In the case of engines it is much simpler, owing to the larger reserve which is held, and most retrospective modifications to engines are, in fact, incorporated when the engines are returned to the contractor or Repair Depot at specified overhaul periods.

Control of Modifications at the Source

Obviously unnecessary modifications should be eliminated at their source and, notwithstanding the large number of defects which arise, I believe that most firms are fully aware of their responsibilities in producing a reliable design. No doubt less defects would arise if more time were available for initial testing, if more Drawing Office staff could be found to supervise detail design, if the designers had a better appreciation of Service conditions and if the Service were better trained in the use of the aircraft. A reduction in the number of operational changes is also difficult, and is made more so by the tendency of designers to give first priority to performance and to compromise initially on the other operational requirements. This may not be unsound provided resolute steps are taken, and provided it is possible to meet these requirements quickly by modification action.

Close scrutiny is now maintained by Modification Committees at all times on the necessity for each modification as it arises. The most drastic action ever taken, however, came in 1923, when the Modifications Committee set up at the end of the 1914-1918 War was abolished. This certainly reduced the number of modifications temporarily, but all proposals had then to be dealt with on files passed between the various departments concerned. This procedure was unwieldy; it caused delays in urgent requirements and, in 1930, led to the setting up of the Airframe Modifications Committee, which has been in continuous operation ever since.

From time to time, reviews have been made in an attempt to reduce the number of modifications and minimise their effect on the Service and industry. The result has always been the same, namely, that the total number of modifications could not be appreciably reduced, but certain benefits may be derived by making changes to the system. This has usually meant another change to method of classification.

In conclusion I should like to quote a statement made by the Modifications Working Party under the Chairmanship of Air Vice-Marshal Pelly :—

"We are agreed that modifications must be recognised as an inescapable burden and we are unanimous in our view that whilst it is clearly desirable to minimise their incidence, it must be accepted that modifications to airframes, engines, engine accessories, armament, radio, instruments and other equipment will always be necessary if aircraft in use by the Royal Navy and the Royal Air Force are to be maintained in a state of efficiency, and if every advantage is to be taken of the many improvements of a scientific, technical and engineering nature which have, in the past, enabled this country to maintain a high place in the military Air Forces of the world."

(Acknowledgment is made to the Chief Scientist, Ministry of Supply, for permission to publish this paper.)

THE IMPACT OF MODIFICATIONS ON PRODUCTION

REPORT OF DISCUSSION

Chairman: W. E. W. PETTER, C.B.E., B.A., F.R.Ae.S.

THE CHAIRMAN said that ample material had been provided for discussion and, in particular, it seemed to him that the question of how far it was desirable to have a separate department for putting in modifications, to which Mr. Gilbertson had referred, was one which could usefully be discussed.

The batching of modifications, as another means of reducing the production load consequent on modifications, as mentioned by Mr. Howat, might also be examined.

The Designer's Responsibility

It seemed to the Chairman that in this matter of modifications the designer had a position of very great responsibility, probably equal to his responsibility in producing the aeroplane at all. There were two kinds of modification, the first being the development modification which kept the good aeroplane young, the kind of modification which kept the Mosquito and its engine in being with several types each year for several years. That was one problem which, it would be generally recognised, was essential to solve, and perhaps some of the Production Engineers present would like to comment on the best way of introducing these new types without too much interference with the existing flow of production.

Secondly, there were the detailed modifications which might arise from all sorts of causes and which might or might not be dealt with in the same sort of way. In this matter, the designer had a very great responsibility, which he did not always recognise.

The Chairman thought that, in general, the structural modification was unnecessary; it should have been foreseen. He was not talking about such new and unknown fields as they were now beginning to enter when considering the fatigue life of aircraft structures in civil aircraft. When one left the beaten track, modifications would always be necessary; but the kind of modification arising out of faulty load distribution, or detailed design, should almost always have been susceptible to stress analysis and intelligent testing and should not require modification afterwards.

In aerodynamics the problem was more difficult, but more intelligent, and earlier, flight testing, on more machines, should avoid many modifications. So far as installations in the aeroplane were concerned, while it was not possible to avoid the new radio and radar sets and other bright ideas which the operational side brought forward, a great deal could be done to make the initial installation first-class by good mock-up work. It helped the designer in many ways and it brought in the shop people; they had not time to look at large numbers of drawings, but they could understand a mock-up. In that direction, more could be done to forestall modifications by, for instance, intelligent installation of equipment, controls, etc.

Aiming at Perfection

It might be said that this was increasing the load on the designer, but in the Chairman's opinion it was not worth attempting to put an aircraft into large-scale production unless it was nearly perfect. The money spent on the production of aeroplanes was enormous when compared with the amount which went into design. The extra effort required to achieve something as near perfection as possible in the design undertaken was a thousand times worthwhile. That was a matter on which the Ministry must help, and it must make the conditions sufficiently attractive for a firm to concentrate on aiming at perfection rather than encouraging a multiplicity of hurried designs.

Designing for Modifications

The designer could do a great deal by intelligently designing for modifications. It was extraordinary what a difference there could be between the method adopted by a junior draughtsman and one which had been carefully considered. There were countless examples of intelligence in design enormously helping the people in the shop to minimise the disturbance when a modification was necessary.

Another way in which the designer must help was that, without pretending to wear an Air Force cap, he must be an amateur Air Staff strategist himself and make the customer establish a cast iron case for the modification He must go into the matter in a tactful but thorough manner, before admitting that the modification should be introduced to delay and, perhaps, to some degree spoil—or else greatly improve—his beautiful aeroplane.

Importance of Clarity

Finally, the designer must try to make his object in carrying out the modification, and the manner in which it was going to be carried out, quite clear. One knew from experience of oneself that the standard of intelligence in this world was not very high, and people were very busy. In introducing a modification to the shops, a really well-written modification sheet showing what one was doing, how one intended to do it, when one was going to do it and how one wanted it carried out, would go a long way to ease the path for the all-too-few skilled men who had to do the job.

MR. W. S. HOLLYHOCK (Chief Production Draughtsman, Hawker Aircraft, Ltd.), dealing with the subject of batching, said that he could speak only with regard to small military aircraft, and his views were not generally shared. First, he thought that the prototype was in itself not a production machine. It was essentially a machine designed for high performance. After the prototype had flown, he felt that the best method of introducing production was to have a batch of pre-production aircraft. These could be built with rough tools, and could be subject to the changes which were bound to be asked for during the early production life. In that way, many of the modifications which arose could be cleared within the first 10/15 aircraft, and thus leave the main production clear of modifications, except for those changes which were inevitable.

If the job had been planned satisfactorily, after the prototype had been built a great deal would be learned, and in the following year or so much more would be learned. During that time, the position would be clarified and changes could be introduced with less difficulty and

with less interruption to the programme, than at a subsequent date.

With regard to the subsequent introduction of modifications, Mr. Hollyhock felt that batching was a good thing for all modifications except those of a safety nature. He knew that the Service did not like batching, because it meant on the face of it delaying the introduction of certain modifications. In the long run, however, he felt that it was quicker, because there was not a continuous interruption of flow for the introduction of modifications which required new material and perhaps six months fabrication period for castings, forgings, and so on.

Generally speaking, a batch of something like 20 per cent. of the current order was a useful figure at which to aim, not necessarily 50 aircraft, as had been suggested, though for a big order that would be satisfactory. With an order for 100, to treat 20 as a batch would be a satisfactory way of introducing modifications without unduly embarrassing the production side.

Mr. R. E. Mills (Senior Designer, Bristol Aeroplane Co. Ltd.), said that in helicopter work they had run into a new trouble with modifications. On helicopters, the structure was only one part of the aircraft, and the mechanical side, which in his Company was dealt with by the Airframe Department and not by the Engine Division, was another side. For structure work the trial installation procedure gave a very useful breathing space, because the results were often a foregone conclusion in the sense that one knew what one was going to put in, and that it would be all right.

On the mechanical side, however, the trial installation was a different matter and it was very much more difficult to forecast that some new design or modification was going to work until it had actually been tried. It was found that there had to be modifications to the modifications, which nearly always took place during the trial installation period.

Mr. Mills said his Company found that they were running into considerable trouble with this, because on the mechanical side there were usually greater production difficulties. It might be necessary to produce new castings, to jig up more and do more accurate machining work, so that the trial installation did not give that breathing space which was usually obtained on the structural side. He thought that there should be some alteration to the modification procedure to cover that difficulty.

Mr. H. S. Howat, replying to Mr. Hollyhock, said that it was a realistic approach to try to have a small batch of aircraft in which modifications could be introduced where they were known but, of course, they were not all known until the aeroplane got into service. Moreover, it was not always possible to adopt that procedure, because there was very great pressure from the Services to have the aeroplane quickly. It was necessary to compromise and, in Mr. Howat's opinion, the best method was to put in each individual modification as soon as it could be introduced.

With regard to helicopters, as with aircraft, there were always modifications to modifications. There was no great body of experience on helicopters and it was bound to take longer to get the modifications right.

Mr. A. I. Morgan (Technical Officer (Engineering)), commenting on Mr. Howat's statement regarding increased supervision of detail design by Drawing Office staff, said he presumed that it was generally accepted that many subsequent modifications arose from errors in the Drawing Office. He had recently visited the principal aircraft firms in the Conference area to investigate the demand for draughtsmen, and the diversity of methods of employing draughtsmen in Drawing Offices had become apparent to him.

His general impression had been that Drawing Offices in general were overburdened with the junior or intermediate draughtsman, who could not be trusted to take a design to finality. Such men required considerable supervision and checking, and it might mean taking senior men off a responsible project for the purpose. Moreover, despite extensive and exhaustive checking, bad designs did get through. It was known that this was largely due to the great influx of draughtsmen into the industry towards the end of the War, when almost anyone who could use a pencil or a square had been drafted into a Drawing Office. Some had had no opportunity to get practical workshop training.

He wondered whether the aircraft industry could introduce a system, in easy stages, whereby some of the so-called senior draughtsmen could be induced to take refresher courses in the workshop. There would no doubt be a great deal of opposition to such a scheme, because it seemed to be regarded as undignified for draughtsmen to go back to the shop, but it would be interesting to have views on whether such a scheme could be put into operation.

Mr. V. H. Wilton (Assistant Director, Aircraft Production, Aircraft Supplies Division, Ministry of Supply), speaking as one of those who had to provide an "alibi" when a firm did not meet the programme, referred to those modifications which resulted from the specification issued not being met. He would urge the Design Offices to consider carefully the specification requirements, and the development and pre-production engineers to come forward rapidly with the necessary plans for testing and meeting them.

He had in mind, in smaller aircraft, such things as pressurisation and cabin hoods. Programmes were set for 18 months or two years ahead, and as the delivery time approached, it was often found that the aeroplane would not stand up to pressurisation and also that there was some fault in the hood, apart from any change in operational requirements.

Mr. Hollyhock had referred to the introduction of pre-production aircraft. Would he expect a break in delivery following the delivery of, say 20 aircraft from pre-production, before delivering the first true production aircraft? That point was of interest, because if one were tooling for large-scale production, the tools must be ready when the first production aircraft was put out. If, while producing the first 20, these aircraft were being subjected to modifications, the tools would be affected, and the question arose of whether it would be possible to embody the modifications in the first true production aircraft, without causing a break in delivery.

Mr. Hollyhock explained that his object in having a pre-production quantity was to afford a breathing-space in which to change the tools to the altered requirements, rather than having the whole flow through the production shops upset. One could go on with the aircraft which were being built under more or less freehand methods at the same time as one was preparing and lining up the tool programme for the full production.

Mr. H. G. Parker (Assistant Chief Engineer, Short Bros. & Harland Ltd.), replying to Mr. Morgan, mentioned that at a recent lecture at the Royal Aeronautical Society it had been stated that one aircraft firm, during a recent slack period, had returned quite a number of their senior design staff to the works for a refresher course, with very good results.

On the question of having more senior draughtsmen for detail design, that would apply also to maintenance. Design for maintenance had been discussed at similar Conferences in the past. In both cases, maintenance and detail design, he thought that it would pay to have senior draughtsmen —it might be said that they could not be spared, but he did not accept that—in every office, who had no responsibility for a particular aeroplane, or to anybody but the Chief Designer or Chief Engineer, but whose sole object was to act as miniature consultants—dabbling in everything in the office which concerned bad detail design and bad maintenance.

Reference had been made the previous day to the need for education. There was need not only for education, but for continual re-education, for every junior that came into the office. He had found, over a number of years, that as soon as a junior became a senior he was so busy with his structural design that he forgot all about maintenance, and his juniors had again to be re-educated. They had found such re-education very advantageous over the last few years,

and he himself had a job of that kind at the moment, being free to dabble anywhere in the Drawing Office, and take up anything which he found was detrimental to maintenance or was in the nature of bad detail design.

There was another matter which concerned the same point, from a different angle. He had been concerned for a number of years at the perpetual friction which seemed to exist between production and design in the matter of modifications. He had always felt that it was not necessary. Over their last three prototypes, he had had a careful analysis taken of all the query forms which had arisen from the shop floor up to the time of the first flight. These, of course, were all defects on drawings and did not concern subsequent modifications. He did not speak in justification of the Design Office, but to point out the real truth of the matter. Of the queries raised up to the first flight, the average correctable on the drawings—points such as dimensions missing or stupid mistakes—was in the region of 75 per cent., affecting 10—15 per cent. of the drawings. The rest of the queries arose from bad scheduling, alternative materials because certain materials were not in stock, and so on. In the end, as everyone associated with the Drawing Office would agree, if one checked the final returns for modification work on a prototype arising *from these defects and queries*, it did not amount to more than about 3 per cent. of Drawing Office time.

So far as detail design was concerned—not the best design of a piece of machinery, but a design which would at least come together—the Drawing Office was thus about 97 per cent. efficient He knew that it did not diminish the problem of the production side, for by the time the Drawing Office had finished their 3 per cent. of time spent there was this considerable number—10/15 per cent.—of drawings which had been re-issued from this cause alone, with consequent paper work. They would like to do away with that, but had so far been unsuccessful.

Captain (E) C. W. Jones, R.N. (Director, Military Aircraft Research and Development (R.N.), Ministry of Supply), said that he spoke with some trepidation, in the first place because he was a serving naval officer, secondly because he was in the design branch of the Ministry of Supply, and thirdly he had only had the advantages of a cheap Service education ! He knew that at least two of those qualifications, from what he had heard the previous day, were not entirely acceptable to the Production Engineer.

Mr. Hollyhock had mentioned pre-production aircraft, and had been supported by Mr. Wilton. There had been under discussion for some time a proposal on those lines. The key to the problem of modifications, and to some of the problems which had been mentioned the previous day, lay in the period of five years. If this period could be reduced very considerably it would no doubt reduce the incidence of modifications, but it would still leave the fact that modifications were required when an aircraft first went into service and also during its development period.

If the Services could persuade the Treasury to order an aircraft in a small batch from the moment the staff requirement was agreed by the Ministry of Supply, and if that batch went into service in one or two squadrons, and one then started to think about a second series of aircraft, which would embody modifications learnt from this small number, which had gone directly into service, something might be done to give effect to Mr. Hollyhock's proposal. It involved the problem of a break in production, to which reference had already been made, but personally he thought that it was worth consideration and, in fact, it was actually what was done to a certain extent.

There was also the question of having modification centres. It had not been stated whether those should be Service-manned or civil-manned. He thought that either would work very well. That had been tried, but they had always come up against the problem that each modification was a subject for consideration on its own. It was the circumstances of the time which would dictate whether it was better to embody it in the modification centre or in the works. During the War, on several occasions in aircraft repair yards they had this modification centre technique. For those who did not know what aircraft

Mr. C. E. Fielding (left) and Mr. H. S. Howat (right) with a visitor to the Conference during an intermission.

repair yards were, he would explain that one of the reasons for their inception was that they provided a very flexible medium between inflexible industry and the Service. It always took industry six months to tool up before it could do anything, whereas, at great expense and perhaps inefficiently, it was possible to get things done in the repair yard until industry could " get cracking ".

Mr. Howat had made the point that Service people did not treat the aircraft very well. Captain Jones was prepared to lay it down as an axiom that anything which required skilled maintenance was bad engineering. It must be realised that in a Service, particularly when war began, there was not a vast number of highly-skilled people to call upon; one had to train people very quickly and face colossal expansion. If the aircraft industry could not make aircraft to fit the normal individual who was called a mechanic when he went into the Service, he was certain that the Service could not make mechanics to fit their aircraft.

Mr. A. Vines (Production Manager, Fairey Aviation Co. Ltd.), said that Captain Jones appeared to contend that naval repair yards were highly flexible, while in the aircraft industry it was six months before anything happened. What actually took place was, speaking from the standpoint of an aircraft firm that knew a good deal about the Navy, that the naval repair station got an aeroplane and then worried the firm for the parts needed to incorporate the modification. In fact, the firm carried the repair section.

Mr. Vines suggested that it would be easier to fly aircraft to the factories concerned for occasional overhaul and service. By doing that in a regular sequence, it would be possible to bring the aeroplane up to date more quickly and easily than by borrowing a machine from a squadron and giving it back on a certain day, with or without modifications. It would be necessary to order more aeroplanes to have a few up one's sleeve for modification.

A point to be borne in mind was that 90% of the modifications which arose were due to bad detail design. He thought that a prototype should be ordered which the people who were going to use it would fly, and keep on flying, not keep grounding it for minor development modifications. In that way many of the modifications required would be picked up earlier. The engine and propeller were type tested for endurance, but not the aeroplane.

There was no detail design office which could be right first time on every detail, and obviously there were going to be modifications on such a complicated structure if it were not tested.

To incorporate modifications, the simplest way was for a component to be built in one shop. Instead of having detail and sub-assembly shops, all the sub-assemblies were made in the same shop as the final assembly, and then the supervision of that shop had a better chance to organise

the labour and incorporate modifications more intelligently. Mr. Vines' Company had found that helpful from the factory organisation point of view in the past. They had succeeded in making interchangeable sub-assemblies with interchangeable rivet holes, by means of three-dimensional lofting and envelope tooling which helped with modifications.

If, however, one wanted to incorporate a modification with a forging, it was necessary to wait five or six months to get the forging delivered. When in America during the war, Mr. Vines had visited a firm which had a battery of vertical copy milling machines to produce machined forgings out of blocks from wooden patterns: instead of waiting for the forgers to deliver, they carried a large stock of blocks for the first batches. If the light alloy forging industry had a battery of machines of this type, they could supply ten to twenty sets of rough-cut forgings from billets fully heat treated, provided the aircraft firm supplied a wooden pattern, which would be a great advantage for incorporating modifications and starting new types quickly.

CAPTAIN JONES disagreed entirely with this view, and said he had in mind the type of modification which had to be carried out in a hurry because it was urgently needed to meet some Service requirement.

A MEMBER said that Mr. Gilbertson had pointed out that the machinery available in this country was quite insufficient, and Mr. Walker had stated earlier that it was very often used most inefficiently. It would be interesting to learn what, in Mr. Gilbertson's view, the solution of this question was. Clearly more machinery was needed, and he wondered whether the right answer was that we should in this country, with our limited resources, start specific purpose sub-contractors, instead of having sub-contractors as they were now, taking over overflows in every direction.

It might be better if, instead of the present arrangement, there was, say, one sub-contractor who specialised in machining stringers from the solid sheet. The Ministry would encourage that firm to do that sort of work and see that they had the machine tools needed.

MR. T. GILBERTSON, before dealing with the question of machinery, referred to the remarks which had been made about the number of machines which could be ordered and said that there seemed to be a feeling that it would be good policy to restrict the numbers ordered at the beginning, in order to get some idea of how things were going to turn out. Personally, he was opposed to that view; in his opinion, a bold policy was essential if the Production Engineer was to be satisfied and if the factory was to be run in an economic manner. His own Company had been troubled by having the shop laid out and labour and tooling prepared for certain marks of aircraft and then having a major modification thrown at them, but two years ago he had pointed out the dangers of not ordering sufficient of the earlier mark numbers. The merits or demerits of the type he was not competent to speak about, but it was very important that everyone concerned should get together to see the impact which was likely to result from any delaying tactics in the hope of saving money and getting a better aeroplane. One might get a better aeroplane, but one would get only half as many of them as one would like to have.

With that arrangement, one could not put the people or machine tools on the job, or go to another contractor for alternative work. In other words, the programme was affected, and that demoralised labour and upset the rhythm, which it was very important to maintain.

The first questioner that morning had made a sound point, but he thought that it had been covered by Mr. Petter, and also by Mr. Walker the previous day. It seemed to have been already established by people such as Hawker's that it was important to have a component mock-up, by which he meant an actual mock-up though not a complete aircraft, but a wing, a fuselage and so on. That could be done concurrently with the production of the experimental machine. He endorsed Mr. Petter's remark that the Production Engineer and the designer could get a 3-dimensional outlook by seeing the job instead of the drawings, and it was certainly possible to speed up the eventual production rate as a consequence of making that arrangement.

To play safe did not pay, but it was a big fault of the British people. They should be bolder, and there was a need for more boldness in the design and supply of machine tools, although it was not necessary to spend a quarter of a million pounds on some immense machine tool. He deplored the attitude of the British machine tool industry. It was not keeping up with the needs of the aircraft industry. All aircraft firms had to go to the Continent and to America to get machine tools which they knew could be made just as well and at one-third of the cost in this country. He did not see the sense of allowing British machine tools to be exported at the expense of the British aircraft industry.

He would ask the Ministry of Supply to persuade the machine tool industry to take a more definite interest in these specialised machine tools. All too often the aircraft industry were told that if they wanted only one off, the matter did not interest the machine tool industry. The quantity was a discouragement, but it was necessary for the Government to subsidise and support and encourage the supply of specialised machine tools of an up-to-date type, tracer-controlled and electronically-controlled.

WING COMMANDER L. P. GIBSON (Air Ministry) referred to the sum of £M6½ which had been mentioned as the cost of modification for the Service aircraft. He asked whether that sum included the money spent on the Design and Drawing Office effort to produce modifications which, through lack of man-power both in industry and in the Service, never found their way into Service aircraft at all.

MR. HOWAT replied in the affirmative. The total design effort, he said, was less than £MI out of £M6½. It did not include the modifications which did not find their way into Service aircraft, but he did not think that that represented an appreciable figure.

MR. L. E. BUNNETT (Assistant Director, Ministry of Supply) said he would like to dispel any impression that modifications did not cost money. He was afraid that Mr. Howat might unwittingly have given that impression by saying that an examination of the increased production costs due to modifications, when compared with complete aircraft, indicated that the additional effort required was about 1%.

Later, Mr. Howat stated that one firm which produced a new mark of an existing type each year, for several years, estimated that on the introduction of the new mark, the man hours to produce the whole aircraft were increased by 10%. That might be the actual measure of the cost of the parts required and called for on the modification sheets, but the dislocation of the production flow was enormous.

He could say without hesitation that if it were possible to make aeroplanes without any modifications at all, it would halve their cost. It was very important to get modifications controlled and cut down because, as Mr. Low had stated the previous day, delivery was the essence of the present problem, and if more modifications were put in, it would take much longer to produce the aeroplanes.

Professor Richards had suggested that specialised sub-contracting could be introduced. It was desirable to point out that dispersal had saved this country during the late War and if the whole manufacture of, say, ribs were put in one factory and that factory were hit by an atom bomb, it would be the end of aircraft production in Britain.

MR. A. E. WOODWARD-NUTT (Principal Director of Research and Development (Aircraft) Ministry of Supply), on the question of early user experience with aircraft, said that in what are usually called "official circles" that idea was accepted, and it so happened that it was being tried in three different ways, according to the three uses of the aircraft. For naval aircraft, in one specific case the Ministry of Supply had ordered an additional prototype purely to

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SUMMING UP

by WALTER C. PUCKEY, M.I.Prod.E., F.I.I.A.

Vice-President of the Institution

Deputy Controller of Supplies (Aircraft Production), Ministry of Supply

SO many individual pearls of wisdom have been displayed before you at this Conference that it should be an easy task for me to string them into a necklace which you can take away with you as a Conference souvenir. Anything artificial about the necklace is probably confined to the string and not the pearls. Most men know, of course, that the string is indeed the weakest part of any necklace and, in its way, this typifies one of our great problems today: the ability to organise separate skills and personalities into an efficient composite group.

The control combination, co-operation or, as some say, the co-ordination of separate personalities, each with separate functions, was in fact the principal motive behind this Conference. The organisers set out on "operation combination" with the deliberate intention of bringing together designers and Production Engineers for the good of the whole group. In the last two years I have been struck by the relative aloofness of these two main practitioners, in Government service, in industry and in professional activities. This is not unusual in other sections of industry, and there are fortunately many people who recognise the problem and who are doing something about it.

Who is to Blame?

Is any particular group more to blame than another for such lack of mutual understanding? My own belief, is that the major blame, if blame there is, must attach to the productionist. I went over deliberately to the production side of engineering many years ago because I felt that by temperament, by prodding ambition, I should be more successful there. I accepted automatically the responsibility it entailed, which is to provide more than any other one group that essential urge for completion of the end product without which no Company can live. It is the production executive, therefore, who must reach over into development and design in order to stimulate release for production. It is he who must not rest content until the final customer is satisfied: we hope on time.

How much the productionist appreciates a corresponding urge for completion among his colleagues; a Design Office which delivers drawings on time to him without constant prodding is wonderful, in fact, almost out of this world. A Design Office which ensures that the drawings released are adequately vetted for production is even more wonderful. Let the production man reflect, however, that this is asking almost more than can be expected, in fact, I will say even more than *should* be expected, because the Production Engineer must accept constantly a challenge to his ingenuity and his imagination; he cannot expect others to do it all for him. He must remember too that design skill is not easily measurable in terms of time, and the growing complexity of aircraft must inevitably mean that if the customer is to be satisfied with reasonable deliveries, the production man has to make up time on the manufacturing swings which has been lost on the design roundabouts.

The Two Main Problems

These two problems are the principal ingredients of this Conference—one, the problem of designing for production, and two, how to produce and deliver on time.

What had our two distinguished designers to tell us about Problem No. 1, designing for production? Mr. Walker comes from an aircraft company which has had, since the war, probably more *production* experience than any other, in its large Meteor contribution. This has reflected itself in a higher than average value of output per worker employed, and paradoxically and unfortunately a much heavier redundancy in recent weeks. In programmes, as in aeroplanes, the higher you go the further the drop. A new and spectacular Pegasus, the Javelin, has emerged from the Gloster stable under Mr. Walker's guidance, and we shall naturally expect to find embodied in it those production features which he so lucidly explained in his Paper.

Mr. Walker started with a profound statement—"We must accept complexity". He links modern

Mr. Walter Puckey (centre) delivering his summing-up. On his right is Mr. F. C. Cooke, President of the Southern Section of the Institution, and on his left, Mr. H S. Howat, Assistant Director, Aircraft Production, Ministry of Supply.

aircraft design to the complexity of life itself, and obviously he is no Canute bidding the tide go back.

How refreshing to hear him say that "we must design for production from the outset", and he made the interesting observation that this tended to increase the total man-hours in the Drawing Office, but reduced the total time for completing the prototype.

In different language, but similar sentiment, he encourages the design staff to be "production conscious", and in that he reminds me of a well-known designer turned top manager, who told me recently that he regarded himself now as the representative of the Production Department whenever he went into the Design Office.

Mr. Walker may not have such exalted production representatives in his office, but he does install a certain number of production men to act as his advisors.

The Design/Production Committee was another interesting point made by Mr. Walker, and you will remember the comprehensive terms of reference he quoted.

A Co-operative Outlook

Yet further proof of his co-operative outlook was provided by the importance he attached to the building of prototypes in the production shops, with the old type iron curtain replaced by a less rigid material. This, he said, brought close continuous contact between designer and Production Engineer from the word "go". An incidental advantage which I think of great value is that a considerable percentage of the prototype tooling is suitable for production use, and a real contribution to speed, interchangeability and cost.

Just in case you thought that Mr. Walker had descended from Heaven for this Conference, he did warn us that this collaboration was not always carried out in an atmosphere of calm and swift agreement. I'll bet it wasn't—but how much worth while attempting!

We would have appreciated Mr. Walker's expanded views on those new developments to which he referred only briefly, and which will affect future designs so much. He referred to such things as integral construction, machined contours, large presses and new materials.

Now let us turn to Dr. Russell, whose contribution to the advancement of larger aircraft was so spectacularly underlined at Farnborough, when both we and the Britannia shared an awe-inspired silence.

We can hardly call the Brabazon a production job in the Meteor sense, but everyone is terribly anxious to see Britannia ruling the skies in a few years time, and much depends on the production team to justify the design and satisfy the customer.

Dr. Russell starts by stating emphatically that very little sacrifice can be made to simplicity unless we are prepared to penalise the competitive value of an aircraft, and he makes the interesting point that we should not talk of Designing for Production, but of *Design for Production for Sale*. Here, indeed, is the customer come into his own. How much we now hear of Britain's possibilities in the civil export field, and Dr. Russell gives most impressive statistics to back up these views. "We must", he said, "produce aircraft of superlative quality, and in sufficient numbers, while order books are still open". The last part of his statement is another way of saying we have only a limited time.

Each side, he said, must recognise the limits of manoeuvre available to the other, and complete understanding must be reached between design and manufacturing teams. Dr. Russell, incidentally, refers at some length to excessive "drag", and I could not help feeling that drag is not always confined to the aerodynamic field.

Prototype and Productive Planning

The author suggests that production engineering activities fall roughly into two stages. First the prototype stage, where he supports Mr. Walker in saying that close production interest provides scope for influencing design, particularly in the breaking down of assemblies. The second stage is, of course, production planning itself, where the production man has much less freedom to suggest design change, but far greater control over the manufacturing cycle. The principal objective is so to overlap prototype and production that both time and modification risk are reduced.

Time does not permit mention of all Dr. Russell's very interesting points, but in passing I must comment that when he referred to the importance of wind tunnel work, I was reminded that the term "wind tunnel" is often used by our American colleagues to mean the "front office".

Time and again, when visiting aircraft firms I have been struck by the delay which can take place through the non-availability of electrics, hydraulics, pneumatics, whether Embodiment Loan or otherwise, and these units are required in ever greater degree. Dr. Russell's "functional mock-up" does much to speed up the development of these systems, not only through check testing their functioning, but speeding up their installation, fixing pipe and cable runs and so on. It seems to me that, particularly on smaller

aircraft, the more one can spread the work so that it proceeds in parallel rather than in series, the quicker it will be done.

Adoption of New Techniques

The author, in the latter part of his Paper, makes interesting reference to a number of new techniques. He says at one stage that building up wing panels as described is preferable to machining out of the solid. This is an absorbing subject on which much more must be said. He refers to "'sticking" instead of "riveting" and sees great possibilities in the process, limited only at present by ability to build up confidence. Mr. Povey has much more to say on this.

Then we had reference to plastics, such as Durestos, where one feels that future possibilities are great. We were warned, however, that we shall still have to produce the hard way, and that any new process or material must really prove itself before it faces the exacting demands of the air.

How wise to warn us—and yet few arts have progressed so speedily as aircraft design, where in our life-span amazing leaps onwards and upwards have been made by a bewildering variety of shapes. One feels that if ever there was an industry searching forward for new developments, new processes, new materials and new worlds, it is ours. Dr. Russell, we know, feels that way too, but warns us that while our imagination and goals soar into the air, our feet must remain firmly on the ground.

What a lively discussion we had, with the two authors sitting peacefully on the side-line. I can do no better than to quote the remark made to me over tea by a well-known Ministry personality. He said, "Isn't it amazing that all those people are supposed to be working for the same end!" For myself I was reminded of the two Irishmen fighting each other until they suddenly discovered an Englishman present. They both joined forces and knocked him out. For Englishman read M.o.S.!

My second impression was of the strong need for more and better trained planners, tool engineers, and, let me whisper it, managers. It was obvious that the running-down of the production side of the industry after the War lost it many good men, and produced unstable employment conditions.

My third impression was the great support given to Production Development Engineers. How much I agree with them!

Prototype to Production

Now let us turn to that most interesting double act given by Messrs. Fielding and Povey, entitled "Prototype to Production". Both of these well-known and respected gentlemen come from further North, and bearing in mind the considerable Southern composition of this Conference I wondered if they were thinking of the reply given by the History teacher when asked who were the Angles. He said that they were a race of people who once inhabited Britain—the acute angles went North and the obtuse angles went South. Perhaps, to avoid misunderstandings, I should add that at this Conference all are equilateral.

Mr. Fielding is a man who values practice as a basis for precept, and to show how his planning works has just completed his first Canberra on time. Many of you know the great efforts made to fly the Vulcan prototype over Farnborough, and the combination of inspiration and perspiration represented by Mr. Fielding is most refreshing to us all.

Mr. Povey is no stranger to Southampton, as only a few weeks ago four hundred members and friends flocked to hear his story of Comet production. We enjoyed his earthy comments.

Whenever the name of De Havilland is mentioned today we think of Comet, and just as in my boyhood Halley's Comet stirred imagination, so today every schoolboy, and most American airline operators, know the De Havilland Comet. Yet it is one only of a brilliant family to which Mr. Povey has acted as midwife, and no Company has done more in stretching British wings over the world.

What did we learn from these two gentlemen?

Mr. Fielding has indeed served up a planning feast, and I am sure that many of you will eagerly study it. From his first paragraph I warmed to the author, when he said that it was not possible to exaggerate the importance of forward planning as a major contribution to time saving from the first aircraft onwards. If only we could put the intensity into the first few months that we invariably have to put into the last few, these last few would disappear altogether.

He assumes two major things; one, that the prototype has cleared trials and two, a realistic issue of drawings agreed with Design Office. Certainly a major hurdle jumped at the beginning of the race, but we won't quarrel with him as previous speakers were expected to (and did) carry this hurdle.

"How", "When", "Where" and "Do"

Mr. Fielding has his four principal departments—how, when, where and do,—and we are given considerable detail on the first three which will, he says, help so much when the "doing" is reached. It is really not appropriate for me to re-describe his most lucid explanations, but a few strong themes run through the whole of his Paper. First of all, the time factor is constantly mentioned. "Place material orders quickly" he says, and shows us the sort of paperwork to help. "Plan your tooling on the most simple type for the job", says he, "thus having the dual effect of reducing tooling costs and getting the tools made more quickly". How different from the typical American approach but, under our conditions, probably best.

Another time factor is contained in his statement that sub-contract load should be decided very early in the planning, so that tooling arrangements can be made in good time. This I think is important, and not generally done.

Still on the subject of times and tools, he makes

the interesting point that his Standard Tool Data Sheets and typical drawings enable him so to reduce load and speed service in his Tool Office, that only 20 per cent. of the total tools require special drawings. This is indeed a major contribution to time and money.

I am sure all were interested in Mr. Fielding's man/hour analysis for "guestimating" the time required for the first aircraft. If he used it in the Canberra it was certainly accurate, and I look forward to his Vulcan achievement with much interest. It would be interesting to compare notes over a wider field using Mr. Fielding's chart.

There are other references to time, and this is obviously a strong feature of the planning scheme. He also tells us frequently about his control checks and the necessity for the right sort of information to reach senior executives. How right he is, because the tendency is for these key people to have too much undigested detail thrust upon them, which dulls that much-wanted ability to ask the right questions just before someone else does. It also increases the size of both the brief case and the stomach ulcer they take home at night.

Perhaps the Navy with its time to spare can help relieve their task !

Finally, commenting on Mr. Fielding's excellent contribution, may I refer to his views on interchangeability. Briefly, he says that interchangeability pays dividends. How refreshing to hear that interchangeable aircraft, starting with No. 1 off the line are, and I quote, "a big help in production". I am sure my colleagues in the Ministry will be deeply interested. I hope others in the audience are too.

Closing the Gap

Mr. Povey opened his Paper with *the* understatement of the Conference. "Production Engineers", he said, "are faced with many difficulties"! He decided that his contribution should be devoted to closing the gap between first prototype flight and first production delivery. He gives this period as one ranging from a year to seven years, which, if you add another two years at least for prototype flight, gives us a nine-years stretch from conception to realisation, a period surely exceeded only by the builders of a cathedral. It is indeed no wonder that at least one aircraft supplier has designed a large calendar which is obviously intended to last a long time, with yearly inserts laid on. More seriously, however, Mr. Povey is, like Mr. Fielding, deeply concerned by the time problem and devotes most of his Paper to ways and means of reducing it.

He begins by breaking the overall time in elements and adopts the sound practice of tackling each one separately. First and indeed very foremost, particularly on civil aircraft, is strength of customer interest. How soon can he be persuaded to make up his mind ? Will he order "from the drawing board" or will he, as many do, see the prototype flying at Farnborough before signing on the important line ? A Company such as Mr. Povey's takes great risks indeed, and he is justifiably proud of its courage. I know we are too.

I believe that one of the most important problems confronting us, in both civil and military skies, is to get a production programme settled at an earlier date. When you analyse the confidence that a customer wants, you are led to the view that two things are tremendously important; one, confidence in the supplier, and two, a realisation that aerodynamically, performance may now be calculated within close limits, and could be available to the customer long before prototype flight. The really difficult answer to give is *when* the production machines can be provided, and here we have our greatest variable. Here we have, as Mr. Povey demonstrates, our biggest problems and our great hope for the next five years. How expensive taking risks can be ! Mr. Povey's example of manufacturing five sets by freehand is, unfortunately, all too common, and places tremendous strains on skill, machine capacity and cost. It is appropriate once again to mention here the point Mr. Fielding made on tooling economies.

I was very interested in the author's reference to modifications. "If we wait", he says, "until every part is stabilised, the time will be great"; his Company were willing to pay £350,000 as a contribution to earlier delivery and customer satisfaction. We should be proud to know that the enterprise was justified. That, to quote Mr. Low, was truly Elizabethan. You will know that similar problems apply to military aircraft, except that the added cost is more diffused. It might be worth mentioning the obvious point here in support of Mr. Povey that the longer the period of aircraft design and planning, the greater the risk of modifications. What better argument for narrowing the gap !

On the subject of co-operation Mr. Povey also places good production men in the Design Office, and using a similar technique, he installs Methods Engineers in production departments to guide the project through initial stages, and to enable that much harassed group of shop supervisors to concentrate more on the eccentricities of those who work for them.

Importance of Spares

Thank you, Mr. Povey, for remembering one important item—Spares. All industry is backward on after-service, and the aircraft industry is no exception. I certainly noticed a few consciences stirring in their seats when he mentioned that word. It is not good on the military side, and will be even more of a problem and an obligation when we build up our civil deliveries. Spares delivery should certainly be one of the vital statistics top management has on its desk.

I was getting alarmed about the trend of the discussion which followed. Mr. Povey was in his aggressive mood and gave the M.o.S. some blunt advice. "Make up your mind" said he, and I was grateful that we have indeed now made up our minds on the future military programme.

I thought Mr. Scott Hall made a profound point in the discussion. In effect he said that his whole training as a design man told him to produce prototypes as an end result. He realises now that his real job is to help in producing *numbers* of aircraft. What a significant difference, publicly acknowledged, through closer acquaintanceship with production men.

What about the rest of the discussion ? Some very good points were made and I don't propose to repeat them here. I must, however, remind you of almost the one point on which full agreement was reached between audience and platform. Mr. Worth said that if we want (and how much we do) more trained production men, we must train more. Seven Designers, he said, were trained to one Production Engineer. The facilities were there, but the students were not. Mr. Povey's strong practical support of both Mr. Worth and more training was indeed appreciated. More power to their efforts, because the strain on our too few production managers is all too great.

Our theme of organised co-operation was again strongly supported. Mr. Povey warned us, however, to be careful what sort of a production man we put in the Design Office. If he was bad he did harm, and if good he would soon end up as a pillar of the office and, no doubt, two columns of the Royal Aeronautical Society Journal.

Finally we saw Mr. Povey's tool brick-layers at work and I forecast a run on concrete mixers shortly.

Altogether an enjoyable and instructive debate.

Modifications

And now for the session on "Modifications". Mr. Gilbertson is a man with his feet well planted on the ground, and he is always on good ground, as you will have noticed. Mr. Howat is a relative newcomer to the Directorate of Aircraft Production, Ministry of Supply, if not to aircraft, and like all who are in that Ministry is highly skilled and reasonably sympathetic to industry's requirements.

It was the intention of each of these two gentlemen to be complementary to the other in his contribution, and I hope you agree they succeeded admirably.

The word "modifications" has built up for itself a reputation in the aircraft industry unequalled (and indeed unwanted) by any other industry. The art, in its scientific progress towards finality, has always been on the move and military requirements dictate a constant search for the best. Unfortunately the best is often the enemy of the good, and I foresee over the next few years a relatively more serious modifications problem, largely because of the impact of so many new techniques. For this reason greater attention is being given by the Ministry of Supply to modification problems, and the discussion we have just had is more than opportune. We cannot, unfortunately, deal with it in the manner of a certain manager who told me once that, during the War, he deferred the opening of the morning's letters until after the day's batch of aircraft was delivered, otherwise they would be stopped by incoming modifications.

What did we learn from this Session ?

Generally, the impression was provided that the impact is pretty hard, and Mr. Gilbertson's statement that at times up to 50 per cent. of works staff time and 25 per cent. of tooling capacity is absorbed by modifications certainly shakes one. His description of modification procedure is reasonably well known, although I would like to say in passing that strong attempts are being made in Ministry circles to help; Mr. Howat referred to this.

I suppose the right way to approach modifications is in the spirit of the advice given to the young man who wanted to get married—Don't. In other words, don't have the modifications.

One cannot help reflecting that two major contributions to this idea can be made; one, greater care in preparing the operational requirement or basic specification and two, the speeding up of that gestatory period, conception to realisation. Perhaps one can add an important third—more consolidated skill and co-operation among designers, draughtsmen and productionists, which can only be achieved by a reasonably stable industry.

But some modifications are inevitable, and Mr. Gilbertson has very useful observations to make in dealing with them; in the main they follow very closely the precepts laid down by other speakers yesterday, and double blessings flow from their observance.

Mr. Howat is one of the many pillars of strength in the Ministry of Supply. He has done a very good personal job recently on Modifications, and speaks therefore with solid achievement behind him.

He divides modifications into two main groups; the largest numerically but the smallest in man-hours, is rectification of the original design; the smallest numerically but the greatest effort is due to new requirements. In the second category, Mr. Howat repeats what has already been said, that is : get into production before the new requirement arrives, and bring improvements along afterwards. So said Mr. Povey also. I must say that his estimate of the increased production costs due to modifications (he says 1 per cent.) is surprisingly small.

Mr. Howat ends on the very realistic note that modifications, like income tax, will always be with us, and we might as well use the best ways of dealing with them.

Two Types of Modification

The discussion was opened brilliantly by Mr. Petter, who referred to two types of modification, in particular the development modification which keeps good aircraft young. I suppose the real problem here is to realise when it isn't worth while keeping the old boy alive.

He also put in a request for better design work at the beginning, and used a potent phrase "the designer can help by designing for modification". This is certainly a new twist, and adds to the number

of things he should design for. It needs putting over carefully to avoid misunderstanding.

Some disagreement arose on this question of batching, and particularly concentrating modifications into the early batch. Grand work if you can do it, but more and more time is being taken on technical clearance, with corresponding delay in reaching Service or customer. This I think affects the problem considerably, although Mr. Woodward-Nutt told you of efforts to anticipate.

Mr. Vines made a most interesting point on the quick manufacture of small quantities of forgings. The idea of equipping the forgers with batteries of contouring machines, using wooden or concrete patterns supplied by the firm, is worth examination. I'm going to pursue this point, as anything which can speed up forging delivery and machining at less cost is attractive.

The person who sums up has, generally, an unfair advantage over others as they have no opportunity of answering back if they don't agree with him. In any case, I am your customer, and as a Civil Servant, however temporary, I must avoid being controversial almost to the point of dullness, but I will be pardoned, I am sure, if I embroider the discussion with my own observations which, I repeat, are my own. You realise, of course, that just as a casual visitor to New York feels perfectly able to (and often does) write a book about America, so I, after two years in the aircraft industry, know all there is to know about it !

A Significant Pattern

Seriously, however, there are certain threads running through the whole of this Conference, and my job is to pick out a pattern which I think is significant. Using another metaphor, I suppose I could be regarded as a catalyst among the pigeons, and I hope this does not mean that I will eventually get the bird.

The first and foremost thread at this Conference is co-operation, and we have had many practical examples of how it works, including this Conference itself. I hope that industry, the Ministry and our professional bodies will continue on the high level reached here.

My second thread is *TIME* in capital letters. How many of our problems relate to it, and how good a measuring stick it is if we use it constantly. Time is the essence of every new design, which is only fully of value in relation to its own period; time is the essence of customer satisfaction. I often feel, incidentally, that we embarrass ourselves and our customers by showing aircraft at so early a stage, particularly today when gestation takes so long; hope deferred maketh the customer sick ! And certainly breeds changes in requirements.

My third thread is "operational requirement". How much more important it is today to be near right first time. Terrific costs, complexity and time scales make it much more difficult to change thoughts in mid-air, and there are some glaring examples today where more put in and stuck to at the beginning would have helped considerably later on.

My fourth thread is more precise planning. One or two exceptions do not interfere with my regret that aircraft production target dates are notoriously bad. I wish we could more generally devise and use planning methods which would set precise milestones along the road to delivery, and controls which would enable us to check more frequently where we are *en route*. This is important from military and civil points of view. Non-reliability of delivery to the Service means, more than ever before, much waste in ancilliary services, apart from strategic difficulties in an international scene. To the civil operator it has its very obvious drawbacks too.

Thread No. 5 is the breadth of production responsibility. The Production Engineer must devote much more attention to those activities which are to the right and left of his main job. On the left, such problems as forging supply have become real bottle-necks that occur more frequently now that intricate materials and shapes are wanted. To the right, he will find growing delays in technical clearance which hold up delivery to customer, and whether these be called C.S.A. or C. of A. clearance does not matter so much as the effect they have on final delivery, and the need for putting more planning and control into such necessary activities in the interests of "Operation Reduce Gap".

My sixth thread could be debated at length, and has indeed been supported strongly by speakers. I refer to the great need for more production research into new techniques, new processes and new materials. A year and a half ago I set up a Directorate of Production Development in the M.o.S. and a number of firms are realising that it is just as important to have a few people looking over the heads of the Production Engineers into the future as it is on the product design side.

Examples such as "the heavy press problem" come to mind, and were referred to by Mr. Walker as a significant contribution to the future. The U.S.A. has spent the equivalent of £M176 on its "Operation Big Squeeze" programme, and the whole art of extruding, forging and precision machining is rapidly changing. Its effect on design and production will be considerable.

We are not, incidentally, sitting still on the heavy press business, and in a few months our design and production people will move ahead into the next stage of knowledge. Realise, however, the tremendous costs involved which few firms can afford. One leading forger told me only this week that some aircraft designers have no conception of the production problems involved in their new designs. He said that if they were in the ship building industry, they would probably specify the funnels of the "Queen Mary" as extruded tube.

The tremendous growth of intricate machining on modern aircraft has already created a major bottleneck in the defence programme, fortunately now being rapidly cleared. When you consider that a modern fighter has probably five times the machine hours of its wartime predecessor, and six times the weight of ever more intricate three dimensional

forgings, you realise how many more production problems exist.

Research on Machine Tools

We need much more research into machine tools of all types with particular regard to easy setting, quick manipulation, higher spindle speeds and automatic controls to reduce man hours. Mr. Gilbertson will tell you all about it. Every time the technical specification of a new aircraft is prepared there should be a corresponding production assessment so that, if ordered, the design and production arrangements go along in parallel.

I must control my enthusiasm in the interests of your patience, and mention only one more thing. The Parliamentary Secretary referred yesterday to recent changes in the Air programme. Having played an intimate part in this I can say with full conviction that, despite local difficulties, the new military programme gives great opportunity to the industry. Our rate of climb, while reduced, is still positive, and probably healthier than before because it is more realistic and gives also that greater opportunity, which the industry has so long required, to show the world what it can do in the civil and export markets.

Despite all our good-natured grouses, the industry has never been so strong technically and production-wise. We have the designs, we have poured tremendous strength into our men, our buildings, our equipment and our machine tools. What more can we ask for ?

The two words we have been writing in the sky as a hope to the West and a warning to the East are AIR POWER. May I suggest, without being accused of bias, that Air Power is made up of three other powers—Design Power, Production Power and Operating Power. And the greatest of these is—all three !

DISCUSSION ON "IMPACT OF MODIFICATIONS ON PRODUCTION"

(Continued from page 179)

give it intensive flying and rough handling trials. In the R.A.F. it had been the custom with recent types to put the first half-dozen operational aircraft into one squadron and to submit them to hard intensive flying, with the same object; with civil aircraft, it was customary to take an early production aircraft and do a series of proving flights over the different routes to be traversed, both in order to perfect the operating technique and also to get intensive user experience with the aeroplane.

Another point on which he would like to comment was the importance of bearing the probability of modifications in mind right at the outset when planning for production. Mention had been made of arrangements having to be made so that control surfaces could easily be changed. That might have been the case in the past, but it was less likely to be so in the future, owing to the increasing use of powered controls, and experience with recent prototypes had borne this out.

He was a little alarmed at the tendency to introduce specialists on various features into Drawing Offices. It had been suggested that there should be introduced a specialist in design for ease of production, and a specialist on design for ease of introduction of modifications. He had previously heard suggestions for specialists in design for reliability and ease of maintenance, specialists in design for light weight, and so on. Might it not be better to have a few specialists who concentrated on designing first-class efficient aircraft ?

DR. A. E. RUSSELL (Bristol Aeroplane Co. Ltd.) said that large aircraft were perhaps a little different from those discussed in the general run of the discussion that morning, more especially if they had to be built to a fixed price. His Company had found it necessary to introduce what they called a charge order system, which was a form of modification procedure. Each installation had its own specification—the hydraulic system, the radio and so on—and those specifications were written up in three stages. The first stage was one which described general principles, and was agreed by the operator at that stage. The second stage described the detailed application of general principles to the aircraft in question. The third stage was a full description of the complete installation and a complete list of all the equipment used therein. The specification was sealed at each stage, and any change from an agreed arrangement had to be paid for by the appropriate party.

This discouraged changes on both sides, and also encouraged a very close scrutiny of the system proposed in the first place.

Maintenance was one of those design aspects with its own specification, and there they had not only a specialist maintenance engineer on the design staff, but also a resident maintenance engineer from the operators. These engineers were brought in in the early stages, shown the proposed arrangements on the drawing-board, later inspected them on the mock-up and served as consultants to the design team.

One source of trouble possibly arose from trying to make the prototype fly too soon. If more time was devoted to eliminating trouble before the prototype flew, the flight of the first production aircraft might well be accelerated.

THE CHAIRMAN, before calling on Mr. Howat to wind up the Discussion, said that there were two points on which he wished to comment. One was machining from the solid for modifications to the prototype. He was sure that they had to do this, even if it meant using new heat treatments and even some modification in the strength of the materials used, because they could not wait five months for forgings.

He entirely agreed that they were not going to get the results which they wanted by introducing yet more specialists, but by education and getting a right balance of emphasis on the part of the Chief Designer and his immediate staff, whether it was a question of maintenance or of production problems or whatever it might be.

MR. HOWAT said that Captain Jones had referred to batching by introducing small numbers of aircraft. As Mr. Gilbertson had said, that was unacceptable to the production side, who wanted a good long run, but there was another point to be considered. Modifications were in the main of two types. One type was closely connected with a particular aeroplane, the defect type of modification, and something could be done to eliminate that in the early stages. As had been said, intensive flying trials were carried out in the R.A.F., and an aircraft firm were analysing the data, so that in course of time they ought to be very much better off. There was, however, the other type of modification, which was not tied to a particular aeroplane, but which resulted from Air Staff requirements. As time went on and the Air Staff accumulated experience, and as the enemy tried new tricks, modifications became necessary which could not be introduced at the beginning, but which had to be catered for in the production line.

In reply to Mr. Bunnett, Mr. Howat said that he had not intended to minimise the effect of modifications and agreed that the major impact was in the possible dislocation of the production line He had not been able to go into that more fully because it was very difficult to get data on it. If Production Engineers would study it more, they might arrive at some means of controlling the problem.

REPORT OF THE MEETING OF COUNCIL

Thursday, 29th January, 1953

THE Third Council Meeting of the present Session took place at 36, Portman Square, London, W.1, on Thursday, 29th January, 1953. Mr. Harold Burke, Chairman of Council, presided over the meeting, which was attended by 37 Members. Also present were Mr. G. H. Whyatt, Chairman of the Manchester Graduate Section, and Mr. J. D. Robinson, Chairman of the Newcastle Graduate Section.

Council dealt with the routine business of the Institution.

Statement by the President

Sir Cecil Weir addressed the Council and said that he was deeply conscious of the honour which had been done him in electing him President of the Institution. However, it had so happened that, shortly after taking office, he had been invited by H.M. Government to head the U.K. Delegation to the High Authority of the European Coal and Steel Community in Luxembourg. In consequence of accepting this appointment, Sir Cecil was inevitably spending much time in Luxembourg and could not devote as much time as he would like to the activities of the Institution.

He felt it only right, therefore, to state at this juncture that if Council followed the usual custom of inviting the President to accept office for a second year, he would feel unable to accept.

In conclusion, Sir Cecil expressed his great satisfaction with the progress being made by the Institution.

In reply, the Chairman said that Council fully appreciated the President's position. They greatly regretted the decision which the President had felt bound to make, but the Principal Officers felt, very reluctantly, that they must accept it. The Institution's loss was the nation's gain.

Election of Past Presidents, 1953/54

The following were elected to serve on Council for the ensuing year :

Major-General K. C. Appleyard, C.B.E.
The Right Hon. Viscount Nuffield, G.B.E.
J. D. Scaife.
Dr. H. Schofield, C.B.E.

Election of Vice-Presidents, 1953/54

The following Past Chairmen of Council were elected :

T. Fraser, C.B.E.
E. W. Hancock, M.B.E.
J. E. Hill.
Walter C. Puckey.

Finance

The Institution's Income and Expenditure had run true to budget since the beginning of the year.

Articles of Association

Council debated at some length proposed changes in the Articles of Association. The proposals were referred to Section Committees, and will again be discussed at the next Council Meeting.

Standing Committees

Council adopted a recommendation by the F. & G.P. Committee that Standing Committees be permitted to appoint an alternative representative to attend meetings of the F. & G.P. Committee, in the unavoidable absence of the Chairmen.

New Headquarters

Active negotiations were proceeding to acquire new premises, and various properties had been inspected. One property in particular appeared to be suitable, and the Principal Officers were now awaiting surveyors' reports.

Education

As a result of recommendations made at the October Meeting of Council, a small sub-committee had been set up by the Education and Membership Committees to review in detail methods of achieving a "broadening of the base" and its effect on membership and educational policy.

Membership

Council were reminded that the grade of Intermediate Associate Member would cease to exist as from 30th June, 1953. Members still in this grade would have every opportunity to transfer to a higher grade before the expiry of this period.

Institution Papers

The Papers Committee reported that the following arrangements had been made :

The Sir Alfred Herbert Paper, 1953:

"Industrial Applications of Atomic Energy" by Sir John Cockcroft, Head of the Atomic Research Establishment at Harwell. This Paper would be given in the Sheldonian Theatre, Oxford, on 24th July, 1953.

George Bray Memorial Lecture

Sir Harry Pilkington, Chairman and Managing Director of W. H. Pilkington, Ltd., and Deputy-President of the F.B.I., had accepted the Institution's invitation to present the First George Bray Memorial Lecture, taking modern production methods in the glass industry as his subject. The Paper would be given in Leeds, towards the end of 1953.

Research

Two Sub-Committees of the Joint Committee on Measurement of Productivity had been formed, one to deal with "Production Control" and the other with "Works Statistics". The Committee reported that it had already been necessary to issue a reprint of the Report on "Work Study Application and Training", in response to heavy demand. It was interesting to note that some of the recommendations made in the Report were already being put into effect. A School of Work Study had been established at the College of Aeronautics, Cranfield, and a Department of Work Study had recently been set up by the Engineering and Allied Employers West of England Association, actively assisted by the Institution. The B.S.I. had also already set up a Committee on Work Study Terminology, as recommended in the Report, on which the Institution had two representatives.

Materials Handling

The Memorandum being prepared by the Sub-Committee was in final draft form and would be published this year. Work was continuing on the Survey of Materials Handling Practice, in collaboration with selected trade associations.

The Sub-Committee were now concentrating on education in Materials Handling, and a draft Syllabus was being prepared for circulation to technical colleges.

Standardisation

The Standards Committee continued to co-operate with B.S.I. in appointing Institution representatives to serve on Technical Committees, and commenting on specifications.

Hazleton Memorial Library

The Library Service continued to be used to an increasing extent. The work of the Library Committee and Maintenance Sub-Committee had undergone a gradual change, and the two Committees had been reconstituted to avoid any overlapping.

Formation of New Sub-Section

Council approved a recommendation by the Leicester Section Committee that a Sub-Section be formed at Peterborough.

Local Section Reports

Council adopted the Local Section Reports, extracts from which appear on page 192.

Applications for Membership and Transfer

Council approved a number of applications for membership and transfer. Particulars appear on page 190.

Obituary

The deaths of the following members were recorded with regret:

Members

J. U. Brown; W. H. Milnes; J. W. Moffatt; W. Powell; P. Siddens; T. J. Truter.

Associate Members

T. G. Bagley; D. E. Kent; R. Earnshaw; J. Harrison; G. W. Oakes; L. H. Rhodes; B. Wilcockson.

Graduate Member

D. Gould.

Date of Next Meeting

Thursday, 23rd April, 1953, at 11 a.m., at 36, Portman Square, London, W.1.

REPORT OF ANNUAL GENERAL MEETING

Thursday, 29th January, 1953

THE 31st Annual General Meeting of the Institution was held on Thursday, 29th January, 1953, at 4 p.m., at the Headquarters of the Institution, 36, Portman Square, London, W.1. The President, Sir Cecil Weir, K.C.M.G., K.B.E., M.C., D.L., was in the Chair.

Annual Report of Council

The Chairman of Council (Mr. Harold Burke), in moving the adoption of the Annual Report of Council, said that with the permission of the meeting he would take the Report as read, as it had been published in the January issue of the Journal.

He felt that he ought to record some disappointment at the small number of members present, but it seemed to be a well-established practice in the Institution that at the Annual General Meeting it was just possible to get a quorum. He could only assume that the presence of so small a number meant that members were reasonably satisfied with the results described in the Annual Report.

Special Committee on Organisation

Commenting on some of the matters dealt with in the Report, Mr. Burke said that the Report of the Special Committee had exercised the minds of Council during the past year. That Report had been approved in July, 1952, and was in process of being implemented. Some of the proposals in the Report had been put into effect, mainly those concerning the structure of the Journal and the method by which it was compiled. Two Committees had been set up in place of the Technical and Publications Committee, for reasons which were properly explained in the Report.

The results of that reconstruction were to be seen in the January issue of the Journal. He hoped that all members would feel that a good start had been made in this direction. The two Committees, under the leadership of Mr. Seaman and Mr. Dimmock, with the very valued assistance of Miss Bremner, as Editor, had contributed in no small measure to this major step in the history of the Institution.

He wished to pay tribute to the work done for the Institution over a long period by the Technical and Publications Committee and by the members of the staff who had contributed to the success of that work.

There were other aspects of the organisation of the Institution which called for amendment of the Articles of Association, and it had been a useful experience to look at the Institution, its organisation and its growth, and consider just how the Institution could be improved.

Education

On the educational side, Mr. Burke thought that the most outstanding achievement during the year had been the acceptance of the Associate Membership Examination by the Burnham Committee of the Ministry of Education.

Institution Papers

Under the heading "Technical and Publications", history was recorded by the start of "Institution Papers". The first Paper had been presented on 19th March, 1952, by Mr. F. H. Rolt. The Paper had been a very good one, and there had been an excellent attendance. A most interesting discussion had arisen, and Mr. Rolt had been asked to give the Paper in a number of regions of the country, which he had done.

In the coming year, the Sir Alfred Herbert Paper would be given by Sir John Cockcroft, in Oxford, in the summer. There would also be the Viscount Nuffield Paper, and a new Paper, the George Bray Memorial Lecture, which it was hoped would be given in Leeds, in memory of the late Colonel George Bray.

Mr. Burke felt that these Institution Papers set a standard which was important on a national basis. If they could be transmitted to the regions, so that the Sections could have an opportunity of hearing these eminent speakers, it would be a great step in the right direction.

Local Sections

The Annual Report quite rightly laid emphasis on the activities in Local Sections. Mr. Burke believed that it was in the virility of the Local Section Committees and their leaders that the strength of the Institution was to be found. He had been privileged to visit a number of Sections and it was his ambition to go to every Section during his term of office. He had been very much impressed not only by the enthusiasm shown in the Sections, but also by the different points of view. He wished to take this opportunity of saying how grateful Council were to the Section Presidents and their colleagues on the Section Committees for the splendid work they were doing all the time in the interests of the Institution.

Sections outside the United Kingdom were increasing their usefulness and enthusiasm, and were a source of stimulation to both sides. Mr. Pryor had taken over the task of corresponding with the overseas Sections and was tackling it with his usual vigour. There had been some very interesting communications from South Africa and Australia during the year. There had been a good deal of correspondence on the subject of Indian education, with particular reference to production engineering, and the same thing applied to Canada. Mr. Burke had had the opportunity of visiting Canada and of seeing at first hand just what the problems were in regard to the Section in Canada and also the educational difficulties. He was glad to say that there were healthy signs that the Canadian Section was now going from strength to strength, and he hoped that there would be a big increase in its membership in the future.

Finance

Turning to finance, Mr. Burke said that he hoped members would agree that the Accounts were in a healthy state. In his capacity as Chairman of the Finance Committee, he could give an assurance that that Committee took its job very seriously indeed. He was glad that the work done by his predecessors was now beginning to show a useful bonus in the way of an excess of income over expenditure, and it was to be hoped that this would continue.

Assistance from Members

Mr. Burke wished to pay a tribute to the members who had assisted him personally since he had taken over from Mr. Puckey last year. Indeed, he felt that Mr. Puckey ought now to be presenting the Annual Report, since it was largely a report of the work done under his direction. Mr. Puckey had set a standard of service which he (Mr. Burke) was doing his best to uphold. He could think of no member of the Institution who had contributed more to its progress than Mr. Puckey had done.

Mr. Burke also expressed thanks to the Vice-Chairman of Council, Mr. Pryor, who deputised for him when he was absent.

Thanks were also due to the Members of Council and members of the various Committees throughout

the country. It was an interesting thought that in an Institution of over 9,000 members, there was an active Committee strength of about 1,000 of those members doing work all over the country and the Commonwealth. When one reflected upon this and realised the enthusiasm and activity that was taking place in all those Committees, one could count it a fortunate thing that in the past, there had been welded together such a body of men who were putting what they knew into production engineering techniques.

Tribute to the Past President

Mr. Burke wished also to pay tribute to the Past President, General Appleyard. On behalf of the members of the Institution, he wished to thank General Appleyard for three years of work in which he had set an example which had commanded admiration from all Sections. For one year General Appleyard had been President-Elect, and he had been so enthusiastic in his job that one might have thought he was in the Chair. He had followed this by two years of activity during which he had devoted a great deal of time to the Institution, and had visited the majority of Sections in this country and quite a number overseas. As President, General Appleyard had commanded admiration for the splendid work he had done, and the genial and charming manner in which he had been able to make people of all types think that they were part of a well-constructed team.

The staff at Headquarters were a first-class team, working together with enthusiasm for the common cause of the Institution. The work of the voluntary workers, and particularly that of the Chairman of Council, would be completely impossible were it not for the assistance given daily by the principal members of the permanent staff. Mr. Burke's own job during the last eight months had been made very pleasant indeed and had been lightened by the knowledge that any information that he wanted could be obtained quickly, willingly and pleasantly. The Institution were very fortunate in having such a staff.

THE PRESIDENT thanked the Chairman of Council for his interesting comments on the Annual Report. In associating himself with the remarks concerning General Appleyard and Mr. Puckey, he said that the Institution had every reason to be proud of the work which had been reported upon and the progress that had been made. The President wished also to associate himself with the tribute to Mr. Woodford and the other members of the staff at Headquarters, because he knew from experience that everything the Chairman of Council had said about the staff was absolutely correct, and that the Institution was fortunate in having such enthusiastic and loyal people in charge of the day-to-day activities.

Mr. R. Kirchner seconded the motion for the adoption of the Annual Report, which was agreed unanimously.

Statement of Income and Expenditure, Balance Sheet and Auditors' Report

The Chairman of Council moved the adoption of the Accounts. The motion was seconded by Mr. E. Percy Edwards, and carried unanimously.

Election of Auditors, 1952/53

On the motion of Mr. J. E. Hill, seconded by Mr. G. R. Pryor, Messrs. Gibson, Appleby & Co., Chartered Accountants, were re-elected Auditors to the Institution and thanked for their services.

Election of Solicitors, 1952/53

Mr. E. Percy Edwards moved that Messrs. Syrett & Sons be re-elected Solicitors to the Institution and that they be thanked for their services. Mr. H. G. Gregory seconded the motion, which was carried.

The proceedings then terminated.

ELECTION OF MEMBERS

29th January, 1953

The following were elected to membership by Council :—

BIRMINGHAM SECTION

AS ASSOCIATE MEMBERS
J. Cassidy, A. Turner, T. H. Weaver.

AS ASSOCIATE
A. F. Abdo.

AS GRADUATES
J. E. Boughton, C. Clements, A. K. De T. J. Ingram, R. G. F. Lowe.

AS STUDENTS
M. J. Cooper, J. N. Mookerjee, N. R. Pardoe, J. F. Percival, B. N. Saha, B. Webb.

TRANSFERS

FROM ASSOCIATE MEMBER TO MEMBER
T. G. Woodward.

FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
C. B. Bartlett, H. Colbourne, B. E. Downs, A. T. Gough, W. G. Haggitt, H. D. Hughes, A. C. Jones, C. W. Lowe, E. E. Martin, A. J. Naylon, H. E. W. Taylor.

FROM GRADUATE TO ASSOCIATE MEMBER
R. S. Cashmore, F. H. Clarke, G. L. Hutchinson, B. E. Stokes, R. D. Tomkinson, S. Tonkinson, R. S. Williams.

FROM STUDENT TO GRADUATE
R. J. Rowley.

BOMBAY SECTION

AS MEMBER
C. H. de Sousa.

TRANSFER
FROM GRADUATE TO ASSOCIATE MEMBER
J. S. Manku.

CALCUTTA SECTION

AS ASSOCIATE MEMBERS
R. Lahiri, M. S. Roy.

AS ASSOCIATE
A. V. Abraham.

AS GRADUATE
G. N. Advani.

AS STUDENTS
B. K. Bhattacharjee, D. K. Guha, M. N. Mitra, A. R. Ray, V. D. Singh.

TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
N. K. Ghosh.

COVENTRY SECTION

AS ASSOCIATE MEMBERS
W. Robinson, H. D. Wilson.

AS GRADUATES
G. F. G. Hinings, A. D. Jones.

TRANSFERS

FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
A. Bowman, W. N. Chalker, W. J. Cowell, E. R. Farren, S. Giles, J. W. Lee, H. W. Richards, R. L. Taylor.

FROM GRADUATE TO ASSOCIATE MEMBER
S. Silcock.

FROM STUDENT TO GRADUATE
J. A. Core.

DERBY SECTION

AS STUDENT
K. H. Davison.
TRANSFER
FROM ASSOCIATE MEMBER TO MEMBER
A. Short.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
W. F. Stevens.

DUNDEE SECTION

TRANSFER
FROM GRADUATE TO ASSOCIATE MEMBER
K. Fairweather.

EASTERN COUNTIES SECTION

AS ASSOCIATE MEMBER
M. S. O. Goddard.
AS STUDENT
R. W. Sawyer.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
E. N. Farrar.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
A. E. Adams, F. H. S. Heidenstam, M. J. O'Hare, S. J. Richardson.

GLASGOW SECTION

AS ASSOCIATE MEMBERS
T. H. Campbell, A. Gray, J. Raeside.
AS GRADUATE
W. M. Laird.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
J. D. Darroch.
FROM GRADUATE TO ASSOCIATE MEMBER
J. McCluskey, H. W. Morgan.

HALIFAX SECTION

TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
G. Butler, F. Tong.
FROM GRADUATE TO ASSOCIATE MEMBER
N. Jackson.

LEICESTER SECTION

AS GRADUATES
F. F. C. Gill, K. V. Gutteridge, G. J. Steers.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
S. H. Trott.

LINCOLN SECTION

AS ASSOCIATE
C. J. Standerline.
AS STUDENT
A. M. Hand.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
J. W. Davis, E. C. Dawson, C. W. H. Long, G. S. Self.

LIVERPOOL SECTION

AS ASSOCIATE MEMBERS
J. C. Moore, R. Pagett.
AS STUDENT
R. R. Cottrell.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
P. G. Hewitt, H. C. Rippon.

LONDON SECTION

AS MEMBERS
J. A. Davies, C. J. Delph, G. A. O. Perkins.
AS ASSOCIATE MEMBERS
R. C. Caunce, M. B. Cotton, S. E. Daines, J. G. Elting, R. A. G. Hardy, S. H. Mills, A. H. Ralph, J. L. Summerfield, C. F. G. Weide, S. C. Welsh, H. Wrigglesworth.
AS ASSOCIATES
D. Cemm, R. W. Guy, C. R. Marks.
AS GRADUATES
E. J. Ayres, K. A. Blumenthal, P. S. Catmur, L. S. Doyle, L. E. Eaton, J. E. Furse, H. W. Jones, S. Jovanovitch, F. E. Letchford, R. T. Marshall, A. J. Moore, G. K. Spurdle, C. J. P. Tillyer, J. R. Wells, D. H. Youngman.
AS STUDENTS
R. E. Catterwell, J. A. Cottrell, D. T. J. Ford, M. C. Gilson, L. W. Hartle, J. A. Heaton, P. Kerrin, R. N. Mishra, A. G. Orchard, E. J. Scanes, K. R. Snowden, C. E. Taylor, I. J. Williams.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
A. C. Pike, H. F. Webb.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
W. G. Baller, E. C. R. Barry, M. R. Barton, J. E. Kelsh, R. D. Kerr-Waller, C. E. Knight, J. A. Lind, G. H. Littley, V. Lovett, A. H. Luker, A. G. R. Mackie, H. A. Norris, G. H. Pull, R. Pattinson, A. W. Rodaway, C. G. Rogers, J. Saul, H. Sims, E. C. Tomlinson, L. G. Trim, H. Wright.
FROM GRADUATE TO ASSOCIATE MEMBER
H. W. Barnes, G. R. Burn, D. G. Goscomb, A. J. Heushaw, C. T. John, H. W. Langley, R. H. Varcoe, R. J. C. Whitaker, L. R. Whitby, T. J. I. Wilmore.
FROM STUDENT TO GRADUATE
M. Gledhill, E. G. Hammond, R. S. Jagger, D. A. Thomas.

LUTON SECTION

AS GRADUATE
P. M. Johnson.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
J. S. Best, L. J. Martin.

MANCHESTER SECTION

AS ASSOCIATE MEMBERS
G. Burgess, A. L. Howarth, A. C. Hubble, E. Simkiss.
AS GRADUATE
J. G. Kerr.
AS STUDENTS
P. S. Agarwal, F. Cunliffe, H. Hudson, S. N. Roy.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
A. B. Armstrong.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
E. Abnett, F. J. Harlow, F. Hewitt, C. E. Hill, S. Jenkinson, S. Malcolm, L. J. Pearce, J. Stone, J. Wainwright, F. Wild, V. Yarwood.

MELBOURNE SECTION

AS ASSOCIATE MEMBER
R. S. James.
AS ASSOCIATES
T. S. Cragg, J. Shilkin.
AS STUDENT
J. S. Baker.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
J. D. Duggan.

NEW ZEALAND SECTION

AS ASSOCIATE MEMBER
J. H. Graham.

NORTH EASTERN SECTION

TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
. Kenny.

NORTHERN IRELAND SECTION

AS MEMBER
A. E. Clifford.

NOTTINGHAM SECTION

TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
J. G. Barton, N. C. Hallsworth, A. T. Stone.

PRESTON SECTION

AS ASSOCIATE MEMBER
H. Hirst.
AS STUDENT
K. Broughton.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
F. Westall.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
A. J. Ansell, M. Carter, R. J. Fraser, F. Harling, H. Kay, H. H. Ward.
FROM GRADUATE TO ASSOCIATE MEMBER
J. Fray.

READING SECTION

AS GRADUATE
J. Sparrowhawk.
AS STUDENTS
N. G. Hall, K. A. Perkins.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
A. C. Badger, J. M. Histead, A. I. Morgan.
FROM GRADUATE TO ASSOCIATE MEMBER
R. N. Walker.
FROM STUDENT TO GRADUATE
F. R. Funnell.

ROCHESTER SUB-SECTION

TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
H. L. Adams.

SHEFFIELD SECTION

AS ASSOCIATE MEMBER
C. G. Langford.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
L. P. Hesp.

SHREWSBURY SECTION

AS STUDENT
G. E. Canham.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
G. T. Napier.

SOUTH AFRICA SECTION

AS ASSOCIATE MEMBER
W. A. Rainford.
RE-INSTATEMENT AS ASSOCIATE MEMBER
L. J. Fry.
AS GRADUATE
B. I. Kramer.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
D. H. Adams, R. G. Cookson, A. Mentis, H. W. Pellow.
FROM GRADUATE TO ASSOCIATE MEMBER
R. F. Eskell.

SOUTHERN SECTION

AS ASSOCIATE MEMBER
F. Pickering.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
H. U. Roberts, J. W. Wills.

SOUTH ESSEX SUB-SECTION

AS GRADUATE
A. E. Dixon.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
H. G. Berger, W. F. Nicholas.

SOUTH WALES SECTION

AS MEMBER
L. G. Oxford.

STOKE-ON-TRENT SUB-SECTION

AS ASSOCIATE MEMBER
D. H. Challinor.
AS GRADUATES
A. R. Buckley, G. J. Fletcher, A. F. Meadows.
AS STUDENT
R. Mitchell.
TRANSFER
FROM STUDENT TO GRADUATE
T. Proctor.

SYDNEY SECTION

AS ASSOCIATE MEMBER
R. G. McCulloch.
AS GRADUATES
E. J. Hill, J. E. Slade.
TRANSFER
FROM STUDENT TO GRADUATE
G. V. Hamey.

WESTERN SECTION

AS MEMBERS
W. W. W. Downing, D. Stocks.
RE-INSTATEMENT AS ASSOCIATE MEMBER WITH IMMEDIATE TRANSFER TO MEMBER
J. Carle.
AS GRADUATE
G. E. Heath.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
D. B. Archer, J. E. V. Crumpton.
FROM GRADUATE TO ASSOCIATE MEMBER
F. A. Storey.

WEST WALES SECTION

AS MEMBER
J. F. S. Gazard.
AS ASSOCIATE MEMBERS
J. H. L. Taylor
T. G. Whittam.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
H. P. Sanderson.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
L. W. Davies.

WOLVERHAMPTON SECTION

AS MEMBER
R. W. W. Taylor.
AS ASSOCIATE MEMBERS
W. A. Hewitt, G. Nicholson.
AS GRADUATES
J. W. J. Finch, R. W. Thomas, S. J. H. Wilkes.
AS STUDENTS
E. J. Banks, D. N. Bird, V. K. Ford, L. Jackson, D. A. Simkins.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
W. G. Ainslie, F. Heywood.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
H. Beaman, D. J. Hartshorn.
FROM GRADUATE TO ASSOCIATE MEMBER
D. J. Billau, F. Clymer, R. Cooper, D. G. Wiley.

YORKSHIRE SECTION

AS GRADUATE
G. Metcalf.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
F. H. Eccersley.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
G. R. Cade, C. Hall, G. Knighton, M. S. Nelson, E. Southam, J. N. Stevens, V. J. Wood.

NO SECTION

AS ASSOCIATE MEMBER
P. J. Pennock.
AS STUDENT
O. O. Pratt.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
F. Civelekozlu, F. A. Clarke, S. S. Pritchard, R. Rees.

EXTRACTS FROM LOCAL SECTION REPORTS

Presented to Council, 29th January, 1953

Adelaide

The Secretary's Report to the A.G.M. in October showed that the Section had made progress in numbers as well as consolidating its position as an effective professional body in this State, and the President, Mr. William Gwinnett, in his address, issued a challenge to all engineers to give their best service and skill to beat the present problems of rising production costs.

Bombay

In October, Mr. S. L. G. Wright, B.A. (Oxon.), read a paper on "The Manufacture and Use of Paints". At this meeting, the Indian Wild-Barfield Award for the best paper read by a member during the year 1951/52 was presented to Mr. A. J. Lund, M.I.Mech.E., M.I.Prod.E., for his paper on "Diesel Engine Progress". Two very interesting films, entitled "Jointing 132 kV Pressure Cables" and "Power Cable Laying", loaned by British Insulated Callender's Cables Ltd., were shown in December.

It has been decided to hold a Dinner for members of the Bombay Section before the hot weather sets in, and the Activities Committee are proceeding with the necessary arrangements. It is hoped that this may become an annual event.

Calcutta

In November, Mr. P. J. O'Leary, A.M.I.Prod.E., gave a paper entitled "Mass Production of Bolts and Nuts" and Professor Clifford (U.S.A.) of the United Nations Team who were touring India, gave a talk on "Statistical Quality Control". This meeting was very well attended. On the 10th December the Section was fortunate in getting Professor G. A. Robinson, who has been loaned to the Government of India under the Colombo Plan and is attached to the Indian Institute of Kharagpur, to speak on "Management and Managerial Courses".

A special Committee Meeting was held on the 16th December, in order that the Committee could express certain views to Professor T. U. Matthew who was in Calcutta.

The first Dinner Meeting was held on the 13th December, and is reported on page 159 of the March Journal.

Graduate Section

Mr. N. N. Sen Gupta, M.I.Prod.E., and Mr. N. M. Walton, M.I.Prod.E., are working on this Graduate Section, and it is hoped that the Committee will soon be in a position to ask Council if a Section may be formed.

Canada

The Canadian Section are now enjoying steady progress. During September, two press announcements were made which resulted in 58 enquiries for membership.

On 29th October, members were shown the film, "The Aristocrats of Steel", followed by a discussion period. On 19th November, a tour of Canadian Steel Improvement Ltd., was made. This company has what is probably the most up-to-date die shop in the country and members were able to witness a second shift in operation, on the forging of blades for gas turbine engines.

A most successful Christmas Dance was held on 5th December, in Toronto. This was enjoyed by everyone present and the next social event is looked forward to with keen interest.

Mr. H. L. Ward has been elected Honorary Treasurer for the Section.

Cornwall

The practice in the Section has been to arrange the activities between October and April. If, however, the enthusiasm shown during last year and at the beginning of this year continues, some summer activity will be considered.

The opening meeting of the 1952/53 Session was very well attended, the members turning out in force to hear Dr. D. F. Galloway of the Production Engineering Research Association.

In November, the new President, Captain Frank W. Spencer, delivered his Presidential Address. Directing his remarks chiefly to the younger members, he asked them to regard them as being similar to the ideas covered in the book, *Letters of a Self-Made Merchant to his Son*. The President then presented a paper on "Drop Forging" illustrated by slides and a sound/colour film.

At the December meeting, a paper was presented by Mr. J. Howard Williams, Costing Inspector of Holman Bros. Ltd.

Coventry

A visit to Courtaulds Ltd., Coventry, on 8th November attracted a party of approximately 40, and a talk on time and motion study was followed by a most interesting tour of the factory.

The Section President, Mr. E. M. Price; Vice-President, Mr. B. C. Harrison, and the Honorary Secretary, Mr. R. F. Eaton, again joined members of the Birmingham, Wolverhampton and Shrewsbury Committee at a Regional Committee Meeting, when items of common interest and local activities were discussed. The Committee are pleased to announce that Mr. S. J. Harley, B.Sc., M.I.Mech.E., M.I.Prod.E., Chairman and Managing Director of Coventry Gauge and Tool Co., Ltd., has signified his willingness to become Section President for the 1953/54 Session. Mr. Harley has been co-opted to the current Committee and was welcomed at the meeting held on 1st December. On that date, three members of the Coventry Graduate Section were interviewed in connection with the Schofield Travel Scholarship; the Graduates are to be congratulated on providing this number of candidates.

The annual Dinner and Dance held early this Session, due to the cancellation of last year's function, was fully enjoyed by approximately 400 members and guests. Among the latter were the Mayor and Mayoress of Coventry; Mr. H. Burke, Chairman of Council, and Mrs. Burke; Mr. W. V. Field, Principal of the Coventry Technical College, and Mrs. Field; the Section Presidents of Birmingham, Wolverhampton and Shrewsbury, and their ladies.

Coventry Graduate

An excellent start to the winter Session was made in September by the holding of a "Production Panel" on which several well-known personalities in the realm of Production Engineering had agreed to serve. This was followed in October by the presentation of "Factory Layout for Flow Production" by Mr. R. H. Gore, A.M.I.Prod.E. It is anticipated that this lecture will be followed up with a visit to Vauxhall Motors Ltd., and the formation of a

Study Group on the theme of Factory Layout. A film show in November was well attended, followed by an informal discussion. The final meeting of the year was devoted to Industrial Law, when the speaker was Mr. H. P. Jost, A.M.I.Mech.E., A.M.I.Prod.E., Mem. A.S.M.E.

A works visit to Jaguar Cars Ltd., in November proved to be most popular, some 40 members attending a well-organised and comprehensive tour of the new factory.

To encourage more Graduate and Student members of the Section to submit papers, the conditions of the Douglas D. Davis Award have recently been changed. Papers will now be submitted to the adjudicating panel before being presented to the Section, and the final order of the best papers will then be decided on the night of presentation. There is to be no set subject and the Ten Guinea Award is divided into three parts of seven guineas, two guineas, and one guinea for the first, second and third respectively.

Dundee

During the quarter under review, three lectures have been given to the Section. These are: "Training in Management in the U.S.A.", by Mr. W. F. Millar, A.M.I.Mech.E., a local man who studied in the U.S.A. under the B.I.M. Scholarship Scheme; "Mechanical Inspection" by Mr. J. S. Broatch, B.Sc.; "Apprentice Training", by Mr. W. Heigh.

It is gratifying to the Section Committee that the lectures were well attended, in view of the scattered membership located from Aberdeen to Fifeshire. Very lively and controversial discussions took place at each meeting.

A visit to the transformer works of Bonar Long Ltd., attracted a sizeable company, who were very well received and conducted around the establishment by a number of well-informed guides.

The Dundee Technical College has offered a Production Engineering Course to students and a prominent member of the college staff is on the Section Committee.

One Graduate member has applied for the Schofield Travel Scholarship.

Edinburgh

As stated in previous reports, the emphasis in this non-industrial area must be on membership. Strangely enough, compared with other larger Sections, the lecture meeting attendance is surprisingly good. The meetings have been considerably enlivened by having coffee between the lecture and discussion; this also promotes a lively discussion period.

Eastern Counties

The November lecture was given by two local members, Mr. F. T. Dyer and Mr. R. Hazell. Their subject dealt with the present and future development of the works of Ransomes, Sims and Jefferies Ltd., on a new site on Nacton Heath. For the December meeting, two further local engineers described the design and manufacture of the mammoth walking drag line made by the Ipswich firm of Ransomes & Rapier Ltd. Both meetings were well attended and interesting discussions followed.

This year, the Committee have arranged to have printed on the back of all meeting invitation cards a synopsis of the lecture, and this innovation has proved most helpful to members and visitors.

Glasgow

The first half of the winter Session has now been completed, during which three papers have been given. These were: "Fundamentals of Production Management" by Mr. M. Seaman, M.Sc.; "Methods of Achieving More Economical Production" by Mr. E. V. Graham; "Tracer Controlled Machine Tools" by Mr. P. K. Eisner.

An open discussion, led by members of the Section, on various types of machine tools was held during November. The meeting was very well attended and there was a lively exchange of opinions.

The Committee had the pleasure of interviewing one of this Section's Graduates, Mr. J. O'Hara, who has entered for the Schofield Travel Scholarship, and the Section wishes him the best of luck.

The small number of Students coming forward for the Higher National Certificate in Production Engineering compared with the Higher National in Mechanical Engineering, is causing some concern in Scotland. A letter has been sent by the Section President to all members in Glasgow asking them to guide apprentices in their own organisations, who intend to keep on the production side, into the appropriate classes in the S.3 stage, so that their course will lead naturally to the Higher National in Production Engineering.

Halifax

A separate report of the November meeting which was arranged on Regional lines has already been submitted, but it can now be added that after a recent meeting of Section Presidents and Honorary Secretaries of the three Sections concerned, pleasure was expressed at the good results of this meeting. Arrangements are being made to repeat the experiment next season, when the meeting will be held in Sheffield.

Leicester

The considerable increase in attendance at the opening meetings of the 1952/53 Session has been maintained at subsequent meetings. On each occasion the lecture has been followed by extensive discussion of a high standard.

Towards the end of November, the Leicester Section was privileged to entertain the President of the Institution, Sir Cecil Weir, together with Mr. W. F. S. Woodford, Mr. S. Caselton and Mr. T. B. Worth, at its Annual Dinner. Approximately 150 members and guests, including The Lord Mayor of Leicester, attended.

During the period under review, negotiations have been completed for the formation of a Sub-Section of the Institution in Peterborough, and the exploratory meeting, addressed by the Leicester Section President, Mr. S. Radcliffe, attracted nearly 100 members and guests. In anticipation of Council's approval of the formation of a Peterborough Sub-Section, a programme for 1953 is, at the moment, being planned.

Lincoln

The Session commenced on 2nd October, when Mr. Walter C. Puckey, M.I.Prod.E., F.I.I.A., Past Chairman of Council, gave a lecture entitled "Future Prospects of the Production Engineer." This was a joint meeting with the East Midland Branch of the Institution of Mechanical Engineers and the Institute of British Foundrymen. The second meeting was held at Gainsborough, when Mr. B. P. Cooper, M.I.Mech.E., read his paper on "Apprentice Training," which formed the nucleus of a discussion group. This was the first meeting to be held in this district for over a year, and was well attended by some of the Section's friends in the Scunthorpe area. In November, Mr. B. H. Dyson, M.I.Prod.E., F.I.I.A., read his paper entitled "Production Management's Responsibility for Productivity."

The last meeting of 1952 took the form of a Film Show and Discussion on "Cutting Tools and Tungsten Carbide." Mr. Rew and Mr. Stratford were present to answer questions. The Committee are anxiously watching preliminary arrangements for the formation of a Sub-Section at Peterborough. This will, no doubt, help Lincoln members in the Stamford area. This Section will be pleased to give any support that may be necessary towards building up a Sub-Section in that most important area.

The Section is grateful for the kindness shown by the Principals of the Technical Colleges at Gainsborough, Scunthorpe, Grantham and Lincoln. They are very helpful and encouraging.

Liverpool

As a result of the discussion following Mr. Westall's

lecture on "Steel, The Engineer's Clay", valuable information was obtained for a member from the Hazleton Memorial Library and the Science Museum Library on the subject of hardness number related to machineability. Amongst the visitors at Mr. Cameron's lecture were a number of American technicians from one of the U.S.A. air bases in this area, who were introduced to the Institution by the energetic Honorary Secretary of the Graduate Section. A very useful discussion ensued on the relative merits of American practice and that outlined by Mr. Cameron for the increase of productivity in the machine shop.

There was a very pleasing ceremony preceding Mr. Cameron's lecture, when Mr. Knowles presented a medal to Mr. E. A. Hewitt in recognition of his services given to the Institution as Honorary Secretary of the Liverpool Graduate Section during its first two years.

The Section Committee meeting in October was held at the works of Brookhirst Switchgear Ltd., Chester, by kind invitation of the Section President, Mr. J. O. Knowles. The Committee were given the opportunity to study the production planning layout in the factory and were then entertained to a meal, where they were joined by Mr. Harold Burke, Chairman of Council. At the Committee meeting later in the evening, Mr. Burke spoke on "Broadening the Base."

London

Without doubt, the first part of the Session's lecture programme held during the past three months has been most successful. An exceedingly high standard was set at the opening meeting by Sir Ewart Smith, M.A., M.I.Mech.E., when he gave an address "Some Wider Aspects of Management" to a large and very appreciative audience.

The second meeting was held in Brighton, where members show extreme interest in accountancy and its relation to Production Engineering. A paper with the intriguing title, "The High Cost of Low Overheads" by Mr. C. H. Starr, A.M.I.Prod.E., M.I.I.A., provoked a lively discussion at this well attended meeting. Croydon was the venue of the third meeting and the speaker, Mr. T. Whitwell, F.I.I.A., F.R.A.S., F.S.S., gave, in a most interesting and amusing way, his paper, "Figures as an Aid to Production Engineers". A statistician of no mean ability, Mr. Whitwell proved himself to be an outstandingly interesting and convincing lecturer who certainly gave his audience a new slant on the figures they use in their every-day work. The Section Committee feel that the practice of holding meetings in Brighton and Croydon is worth pursuing, and ask all members in these areas to do their utmost to support the meetings, at which non-members are most welcome as visitors. Mr. H. H. Norcross, F.W.C.A., A.I.Prod.E., gave a paper, "Management Accounting and the Production Engineer". A lecturer with a pleasing and easy style, Mr. Norcross gave a most thought-provoking lecture that stimulated considerable discussion.

The 3rd December saw the revival of the very fine dinner-dances that were a feature of London activities in pre-war days. A well attended and very enjoyable evening was spent by members and their ladies at the Savoy Hotel.

Mr. K. W. Abineri, B.Sc.(Hons.), gave the last paper of 1952, "Modern Finishing Processes". The scope of the paper was narrower than the title suggests and dealt with the painting of industrial products.

London Graduate

The Technique of Tooling Study Group has made very good progress in their aim to obtain and record operating times for standard elements of Jigs, Tools and Fixtures, with a view to comparing on a percentage basis the relative efficiencies of functionally similar elements.

Detail Time Studies and Summary Sheets have been compiled and are included in a full report which can be borrowed from the Institution Library by anyone who may be interested. However, the Group feel that confirmation of their findings would be required before they are applied in practice. The Group is to further its investigations in the forthcoming Session and would welcome comments and new members. Communications should be sent to Mr. G. Wittenberg, Grad.I.Prod.E., 34, Barkston Garden, Earl's Court, S.W.5.

Luton Graduate

This Session's programme opened with a well-attended evening visit to The Norton Grinding Wheel Company at Welwyn Garden City in October. On the 7th October, at St. Albans, Mr. Atkinson of Hercules Cycles Ltd., deputised for Mr. T. A. Yapp by reading Mr. Yapp's paper, "Materials Conservation", and afterwards ably answering questions.

A visit was made by Section members to Production Tool Alloys Ltd., Sharpenhoe, Beds., in November, to see the manufacture of hard metals and cemented carbides. Mr. W. T. Dunning, of Vauxhall Motors Ltd., gave an interesting lecture on "Materials Handling from the Users Angle" on 11th November, at St. Albans. On the afternoon of 10th December, an enjoyable visit was made to Mercer Gauge Ltd., at St. Albans. The Graduates' Evening, when members presented short papers in competition for the Section President's Prize, was held on 15th December, this time at Luton. The prizewinners were E. Pennington—"Materials Utilisation"—First Prize; D. Birchmore—"Training of Production Supervisors"—Second Prize.

It is with regret that the Committee have accepted the resignation of Mr. H. J. C. Weighell, Chairman of the Committee, due to pressure of other commitments. Mr. P. A. L. Signorini has offered to take office until the end of the session.

Manchester

Since the last report, four lectures have been given to the Manchester Section. The opening one, when Mr. Dyson gave his paper on "Measurement of Productivity," was a stimulating start to the winter's programme and was particularly enjoyable by virtue of the attendance of a number of members of the Institute of Cost and Works Accountants. The November meeting was a refreshing change from the usual type of lecture, as the platform was occupied by six representatives of the Anglo-American Productivity Team, who discussed their Report on "Metal Finishing."

Manchester Graduate

In October, Mr. F. W. Walton gave his Schofield Scholarship lecture. On 18th November, the evening was devoted to a Production Panel, headed by Mr. R. H. S. Turner, Senior Section President. The questions were submitted by Graduates to the Panel several days before the meeting, which resulted in a good level of discussion. The Graduate Committee feel that they can strongly recommend this style of meeting to other Sections. The Mechanical Handling Engineers' Association kindly loaned the Section two mechanical handling films, which were shown on the 17th December.

Works visits have been made to David Brown Machine Tools Ltd., Manchester, and Taylor Bros. & Co. Ltd., Trafford Park, Manchester. The visits proved extremely interesting and were well attended.

Melbourne

At the August meeting a paper on "Heat Treatment of Tool Steels" by Mr. J. G. Ritchie, was well received. In September there was a Works Tour of Ogden Industries Pty. Ltd., and also a meeting, when Mr. G. H. Neill, of the Metrology Section of the Government Ammunition Factory, gave a lecture on "Precision Measurement in Tool and Gauge Production."

The Annual General Meeting took place in October, when a "Short History of the Development of Thread Grinding" was read by Mr. D. Burden. The year closed with an Institution Dinner in November, the guest of honour being Sir John Storey, President of the Australian Sub-Council, who spoke on "The Importance of the Production Engineer in Industry and the Necessity for Sound Training." In a short address the Dean of the Faculty of Engineering of Melbourne University outlined the University's plans for the Academic training of Production Engineers.

North Eastern

An address in October entitled "The American Outlook as it Influences Production in this Country," by Mr. R. E. Mann, a Past Section President, was very well received and caused a good deal of thought and comment. A paper on "Mechanical Aids to Production" by Mr. J. E. Steel was supplemented by a first-class film.

The Section was very fortunate in getting Mr. F. H. Rolt to come North to give his Paper, "The Development of Engineering Metrology."

The activities of the Section during the past quarter have been highlighted by a visit to The Bristol Aeroplane Co. Ltd., Sunderland, where the Section Committee and others saw the works in operation and an exhibition of Bristol Sleeve Valve and Turbine Aero Engines.

Northern Ireland

Two excellent coloured sound films were shown at a Film Evening in October, Firth & J. Brown's "First and Best," and "Westland Aircraft Helicopter."

A second Works Visit of the current Session was made early in November to the British Tabulating Co. Ltd., at Castlereagh, Belfast. After a short explanatory lecture on the purpose, use and operation of tabulating machines and card systems, members were conducted through the works to see the various types of machines under construction. A third Works Visit was made to the U.K. Optical Company, Ltd., at Lurgan.

Norwich

At the opening meeting of the current Session the speaker was the Chairman, Mr. K. S. Jewson, his subject being "Production and Culture." Other Sections having a mixed industry may care to have a copy of the address for perusal. This will be forwarded on application to Mr. Jewson at "Librar," Dereham, Norfolk.

In December, the paper given was by a local member, Mr. R. E. Copelin, on "Planning for 5 or 250,000 Parts."

A series of visits to the industrial centres in Norfolk is being made by the Chairman, who has been to Lowestoft, Yarmouth, and the scattered area factories. Many of these firms have a great and honoured tradition of engineering service, but there is a certain lack of interest in the professional institutions. This the Committee and Chairman hope to remove through personal contact.

The Sub-Section was represented by the Hon. Secretary at the recent Inaugural Meeting of the Institution's Education Discussion Group.

Oxford

The Inaugural Meeting was held in November, when a gathering of 120 members and guests were addressed on the objects and activities of the Institution by the Chairman of Council, followed by a lecture on "Low Temperatures in Science and Industry" by Dr. N. Kurti, of the Clarendon Laboratory.

The Committee feel that the development of the Sub-Section is progressing so satisfactorily that application for full Section status should be made by the parent Reading Section at the conclusion of the present Session.

Preston

The Committee are studying the minutes of the Second Graduate Conference at Birmingham, to see whether additional interest can be stimulated in the Graduates and Students with a view to their taking a more active part in Section affairs. The Committee wish to impress upon the junior members that the winter programme should be looked upon as an essential part of their education.

Reading

As reported above, the Inaugural Meeting of the Oxford Sub-Section was held in November, when an excellent meeting took place.

Sheffield

The Regional Meeting held at Huddersfield on 4th November gave renewed interest to the proposed reorganisation of the Institution. A large and attentive audience heard Mr. Rolt give a summary of the Sir Alfred Herbert Paper, 1952.

A very successful Annual Dinner was held on 20th October, when the Section Committee were very pleased to welcome Sir Cecil Weir, Mr. Walter Puckey, Mr. Harold Burke, and Mr. W. F. S. Woodford, and to introduce them to the Lord Mayor of Sheffield, The Master Cutler, and many prominent Sheffield industrialists and friends from other Sections.

The lecture programme has included a joint meeting with the Institute of Welding, when Dr. Taylor, Director of the British Welding Research Association, addressed a full meeting on "Modern Development in Electric Welding". It is proposed to continue this policy of occasional Joint Meetings with specialist societies and institutions.

Shrewsbury

At Oakengates Technical College, Mr. Woollcott gave a talk on "Argon Arc Welding," followed by sound and colour films. The next meeting, at Shrewsbury, was addressed by Mr. Goldsworthy on "The History of the Tube Industry," which proved to be a most absorbing subject.

The Section Committee have heard most interesting reports from their representative on the Papers Committee, and have discussed the question of greater publicity for lectures.

The formation of a Graduate Section has also been discussed.

South Africa

Council's decision regarding the formation of Sub-Sections in Rhodesia and Durban have been made known to Messrs. Gibbs and Pring, of Rhodesia, and Mr. T. H. Horridge, of Durban, and names and addresses of members in those areas were provided to assist in the formation of these Sub-Sections.

It has been agreed that two awards be made annually, at the discretion of the Sub-Council, for the two best papers delivered during the year to the Institution in South Africa. It has also been agreed that one award be made at the discretion of the Sub-Council to the Student obtaining the highest aggregate pass mark for the three subjects in Section 3 in the Production Engineering Diploma Examination of the Union Education Department.

Southern

The opening lecture on "The Comet" had a record attendance of nearly 400. The second lecture on "Production Psychology," by Lt.-Col. I. A. Marriott, was also a success and stimulated an excellent discussion.

Mr. T. Gilbertson, Director and General Manager of Folland Aircraft, Ltd., has been co-opted to the Section Committee to fill the vacancy caused by the retirement of Mr. G. H. Allen, whose services will be greatly missed.

South Wales and Monmouthshire

In order to obtain guidance and to clarify certain issues which were causing the Committee members some concern, the Section President, Mr. E. S. Gregory, invited Mr. Worth to attend an informal dinner party in Cardiff. Problems and queries were put to Mr. Worth and considerable assistance was obtained from the information supplied by him.

In October, several Committee members availed themselves of an invitation to attend the Inaugural Meeting of the West Wales Section.

Western

The Section were very fortunate in being able to arrange for a lecture to be given at short notice (due to the unavoidable absence of the President of the Institution) by Mr. A. N. Irens, on "Electricity as an Aid to Productivity". This meeting coincided with a television broadcast which was of particular interest to members in Bristol, and by the kind co-operation of a local firm, it was possible to include the broadcast as part of the lecture.

The Section has nominated Mr. K. Hayward to serve on the Committee of the Council for Further Education for the South-West.

Western Graduate

The meeting held in Cheltenham in November, when

(*Concluded on page* 201)

THE HIGH COST OF LOW OVERHEADS

by C. H. STARR, A.M.I.Prod.E., M.I.I.A.

An abridged version of the Paper presented to the London Section of the Institution on 23rd October, 1952

GOOD management is a most essential factor in achieving efficiency in the face of the inherent complexities of modern industry. The complexities take the form of specialist personnel, expensive plant and machinery, and involved routines and systems. All these things show up in the accounts under the heading of overheads, and the fact that they are so classified by the accountants seems to be responsible for a good deal of muddled thinking. I want to try and clear up some of the muddle and will begin by drawing a distinction between Financial Accounting and Cost Accounting.

Financial Accounting and Cost Accounting

Traditionally, most of the accounting effort in this country has been concerned with matters of taxation; the conservation and distribution of wealth; and the prevention of fraud—not with the creation of wealth and the attainment of efficiency.

To aid them in their traditional task the accountancy profession has built up over many years a very ingenious and rather rigid system of rules and conventions known as double entry book-keeping which, in the wider sense, is usually called accounting. I, for one, have the very highest admiration for the professional accountants who have all these rules and conventions at their fingertips and who can, with their aid, follow innumerable chains of complex transactions from remote branch offices or minor factory departments of some great concern through to the final balance sheet and profit and loss account, all near enough accurate to the last penny. That is traditional or financial accounting, mainly concerned with accounting for total results and with external financial relations, and it is something which accountants can carry on more or less in isolation.

Cost accounting, on the other hand, is concerned with accounting for details and ascertainment of costs, and with the prevention of waste and the control of expenditure within the firm. It is something which very closely concerns the daily activities of managers, engineers and supervisors and is a subject in which they should take far more interest than they sometimes do.

There is of course far more to guiding the financial fortunes of a firm than mere book-keeping, but I am now simply trying to draw a broad distinction between financial accounting and cost accounting. Although modern cost accounting techniques differ considerably from traditional double entry book-keeping, and have been designed to serve a different end, they are best arranged to interlock and fit in as an integral part of the total accounting structure.

Cost Accounting as a Tool of Management

Under the Companies Act, books of accounts must be kept and the books must be audited as a safeguard against fraud, but so far as the auditors and the law are concerned, it matters little whether a firm makes a profit or a loss. Ensuring a profit, lowering costs and reducing waste are matters of management, not matters of law. The only laws which compel one to install costing systems are economic laws. Management can only blame itself if its costs are too high.

Although the first book on the double entry system was published in the year 1494, it is only within the last few decades that accountants, working with engineers and managers, have adapted accounting procedures so as to fashion tools which can be of great assistance in general management, cost determination, and cost control. Great strides have been made, however, and it seems a great pity that some of the very excellent techniques and systems which are available are not more widely understood and applied.

One explanation of the lack of interest and understanding may be that, on the whole, industry has been on a rising market since the middle thirties, so that there is a whole generation of people in responsible positions who have never had to face the urgent need of cost reduction which came to the attention of their predecessors in the slump of 1931.

The High Cost of Low Overheads

In this country there are some of the world's most efficient firms—but also many very inefficient ones. The latter have been making quite satisfactory profits under the conditions of the last decade or so, but I am absolutely certain that in the next ten years all firms will have to pay much more attention to costs and efficiency.

When dire necessity does force such firms to reduce costs, it is possible that they will make the mistake of trying to do it by retrenchment—by making cuts in capital expenditure and cuts in

operating overheads. While some of these firms may be the better for a degree of retrenchment, they will have to be careful that they do not lower their efficiencies and thereby ultimately raise their costs.

Costs cannot be reduced by merely putting the clock back and leaving it to the foreman to hire and train his own labour, make his own drawings and use old-fashioned machines.

To say the same thing in another way, all competitors can obtain raw materials and labour on more or less equal terms, so the only way one firm can exceed another is by being more efficient in the way it uses its labour and materials. Efficiency, in turn, depends on expensive plant with its high depreciation rates, and on things like good supervision, good training, good tooling, good motion study, good planning, good stock control, and good costing systems, all of which show up in the accounts as overheads. It is usually easy enough for the accountants to show how much these things cost, but it is generally not so easy for anyone to show what it costs to do without them, because merely having them will not automatically lead to efficiency and low costs. The problem is one of skilled management —of knowing how to get value for the money one spends in the form of overheads.

Many of the items of overhead referred to above go to make up the very stock-in-trade of Production Engineers, so it is inevitable that the search for efficiency will only show results to the extent that the wider problem of management is understood, and co-operation with accounting colleagues is exercised.

Budgetary Control and Standard Costing

Most firms now prepare some form of departmental accounts on a monthly basis, and have something which passes under the name of a costing system, but so many of these systems are very sketchy and rudimentary affairs when compared with the best that is available. Not only this, but such systems being mere extensions of the double entry system, are slow in action and tend to give a distorted picture, throwing the spotlight on the past rather than on the present and the future. They seldom reveal true costs; are of little value in controlling waste; and tend to put emphasis on retrenchment rather than on efficiency.

The most effective and highly developed of the modern management accounting tools go under the names of Budgetary Control and Standard Costing. Standard Costing is concerned with determining and controlling the prime costs of labour and material, while Budgetary Control is a means of determining and controlling overhead expense.

In their most highly developed forms budgetary control and standard costing systems embody all that is best in modern management, and to take advantage of their full potentials requires managers who know what management is all about. In this, as in other cases, good tools are wasted if they are not used by good craftsmen.

On the other hand, the fundamental principle behind Budgetary Control and Standard Costing is simple enough. It amounts to working out beforehand what a thing should cost, or how much should be allowed for it, and then promptly throwing the actual results up against the standard, so that vigorous action may be taken at once if the allowed standard is exceeded.

The Importance of Good Management

The first step in achieving efficiency is to make up one's mind that efficiency is something worth striving for, and that to achieve it will require something more than just co-operation, common sense and a few calculations on the back of an envelope. To achieve efficiency one must comprehend the real meaning of management, and be reasonably familiar with modern management techniques. There is no short cut to efficiency.

If any excuse is needed for talking about the right attitude of mind, it is that I should hate to have to reckon up the number of occasions, in various firms, when I have heard foremen and technicians complain, because it has been decided they must sign things like time cards and requisitions, that they are becoming nothing but clerks. Nor would I like to say how many senior managers I have met who maintain that standards and plans and controls may be all right for other firms, but won't work in theirs.

To achieve good results in business, as in any other sphere, one must apply the appropriate principles and techniques at the right time, in the right place, and to the optimum degree. There is certainly no panacea for solving all problems but, having said that, I want now to single out one matter for special attention, namely, the matter of measurement and of judging by results against a measured standard. I am bringing out this point because in the narrow sense it is of particular importance in costing and of direct interest to Production Engineers, while in a wider sense it is, after lack of policy and bad organisation structure, probably the weakest feature of management practice in Britain.

Measurement of Results Against Standard

No engineer or scientist would dream of trying to get on at all without carefully determined standards of length and mass, with precision means of comparison such as micrometers and microbalances. In management, on the other hand, if standards of comparison are used at all they are often of the crudest and most unscientific sort, such as the output or cost achieved last year, or the overhead percentage alleged to be current in some other firm. Whereas it is common practice to measure one's material by weight, it is still the exception to measure one's labour by time study.

The way to get costs down is to cut out waste, through setting standards of comparison which are neither too tight nor too loose, and then to arrange controls which will ensure that any departure from standard will come automatically and immediately to the attention of some clearly designated and

responsible person who can justly be held to account for the departure. One can set standards for all sorts of things—for material usage, for time allowed, for power consumption, for tool breakage, for stationery usage, for machine utilisation, for maintenance costs, for indirect labour costs, etc., etc. It can be done just as readily in the small jobbing firm as in a big firm, a process firm, or a quantity production firm.

For standards to be really effective in practice three things are essential :—

1. The organisation structure must be clear enough, so that responsibility for any departure from standard is apparent.
2. Vigorous action must be taken promptly to correct such departures as occur.
3. Real care must be taken in setting the standards. They should not be global or overall standards, and so far as possible they must be in the nature of absolute standards, based on analysis and investigation, not just somebody's opinion or the average of last year's results.

The setting of standards is, of course, primarily a production engineering function.

If one aims at efficiency, that is, at high relative output with low total costs, then many other matters such as human problems and questions of product quality will tend to take care of themselves. I suggest that many of our present troubles, both in industry and in the nation as a whole, have come about because we have spent ten or twelve years trying to achieve ever-higher output without paying proper attention to costs.

The Incidence of Overheads

There are three elements in the build-up of a cost, thus :—

$$\underset{(1)}{\text{COST}} = \underset{(2)}{\text{MATERIAL}} + \underset{(3)}{\text{LABOUR}} + \text{OVERHEAD}$$

The first item, like most things physical, lends itself to precise calculation and control. The second item, labour, like most things human, is not quite so easy to control or be precise about, but from the costing point of view it is straightforward in that there is only the one component to consider. On the other hand, the third item, overhead, is difficult and complex. It is complex because it consists of a lot of separate items rolled up together, and it is difficult because the effect of each separate component cost depends on something else.

In most firms it is common practice to refer to overhead recovery rates at such and such a percentage on labour. One result of this practice is that all sorts of people, some of whom should know better, jump to the conclusion that high overhead rates mean high costs and that if the rate goes up the thing to do is to prune the overhead services or resist their expansion. That that reasoning is not necessarily true can, I think, be shown best by looking at simple examples.

Consider the manufacture of some mythical product and assume that a building is leased and a supervisor hired to look after the manufacture carried out in it. If we assume that the overheads, which are represented by things like the rent and the supervisor's salary, are £300 per month, that direct labour costs are £200 per month and material costs are £500 per month, our total cost will be :—

Material	£500
Labour	200
Overheads	300
Total Works Cost	£1,000

For an output of 1,000 per month the unit cost will be :—

$$\frac{1{,}000}{1{,}000} = £1$$

and the overhead rate will be $\frac{300}{200} \times 100 = 150\%$

Now, if half the men are sacked and the remainder do twice the work, i.e. if the labour efficiency is doubled, the cost build up will be :—

Material	£500
Labour	100
Overheads	300
Total Works Cost	£900

and unit cost will be :— $\frac{900}{1{,}000} = £\,0.9$

But note that in order to pay the supervisor's salary and the rent, we would, for estimating and pricing purposes, have to use double the overhead rate because :—

$$\frac{300}{100} \times 100 = 300\%$$

If, after doubling the labour efficiency, we had continued to use the old rate of 150% for estimating purposes, we would have been £150 short of the income necessary to pay the overhead expenses. In accounting language, we would have had under absorbed charges amounting to £150.

It is clear that if, in our search for better efficiency, we go in for things like time study, planning, and better supervision, we will increase our overhead expenses, but the resulting improvement in efficiency should be such that total costs come down. In such a case the overhead rate will of course go up, both

because of an absolute increase in overhead expense and because of the relative drop in direct labour charges, but the final result should nevertheless be lower overall costs.

Variation in Overheads

Another important point about overheads is this: suppose the labour efficiency remained the same as in the first example, while the output was brought up to 2,000 units per month by doubling the number of men employed. This is what happens:—

Material	£1,000
Labour	400
Overhead	300
Total Works Cost	£1,700

Unit cost is:— $\frac{1,700}{2,000} = £0.85$

and overhead rate is:— $\frac{300}{400} \times 100 = 75\%$

Finally, suppose the labour efficiency is doubled while maintaining the higher level of activity. In that case:—

Material	£1,000
Labour	200
Overhead	300
Total Works Cost	£1,500

Unit Cost is:— $\frac{1,500}{2,000} = £0.75$

and overhead rate is:— $\frac{300}{200} \times 100 = 150\%$

It will be seen that although the actual expenditure on overheads has remained constant throughout these four examples, the overhead rate for use in estimating and pricing, has varied all the way from 75% to 300%. These examples show that care must be exercised in interpreting the usual overhead rates.

By using examples stripped of all complications I hope that I have been able to show how costs can vary with activity as well as with efficiency, and also that if activity and efficiency change simultaneously it will be impossible to determine the exact position unless one has some independent absolute standards from which to take one's bearings.

This question of activity in relation to normal volume is very important in making accurate determination of actual costs, or accurately estimating costs for price-fixing purposes, because the incidence of the overhead costs varies with activity. Moreover, it is not such a simple matter in practice as the above skeleton examples would infer, because some overheads vary directly with activity, some are fixed and some are semi-variable; some vary directly with works or departmental activity and some with the total activity of the firm.

To control costs it must be known whether a given cost is due to a change in efficiency or a change in activity. Production executives may rightly be rapped over the knuckles for cost increases due to efficiency factors which are within their powers to control, but it is not fair to hold them responsible for changes in cost which are, in fact, due to factors outside their control, such as changes in sales activity.

The examples given are also over-simplified in that they refer to only one department and one product, whereas in practice most firms have a variety of parts and products passing through several departments.

Another test of a costing system is to enquire whether or not it ensures that each piecepart or product bears a just and equitable share of the overhead burden. If not, it is quite possible that some products can be made at a loss, while others are overpriced, without either fact being realised.

It is up to engineers and managers to take a real interest in costs and costing and the measurement of efficiency. We should demand from our accounting colleagues the information and clear picture needed for the control of costs and the improvement of efficiency, without being put off by any hocus pocus about the sacred rites of the book-keeper's cult. On the other hand it must be remembered that accountants cannot provide the required aids without co-operation and understanding, and that in the end it is only we ourselves who can take action to stop any leaks or waste revealed by the information provided by the accountants.

A Note of Warning

I want to end on a note of warning by pointing out that the higher one's overheads the quicker one can swing from a profit to a loss if activity falls off below what is known as the break-even point. If one sets out, therefore, to increase efficiency by putting up the overheads, i.e. by buying better machines and taking on more supervisors, control chemists, Production Engineers, etc., then one simply must see to it that the better efficiency aimed at is attained and, once this is done, one must of course pass on some of the benefit to the customer so as to keep up the volume.

In conclusion, we see that the higher the overheads, the lower the costs, provided that management has sufficient skill to utilise the overheads effectively so as always to keep the volume of production sufficiently high fully to load all facilities.

COMMUNICATIONS

Comment is invited on Papers published in the Journal.
Contributions should be addressed to the Editor,
36, Portman Square, London, W.1.

"MEASUREMENT OF PRODUCTIVITY"

From: Mr. Harry Howell, A.M.I.Prod.E.

May I be allowed the privilege of commenting upon Mr. Dyson's magnificent paper "Measurement of Productivity"? * In doing so it will be difficult to comply with the request to correspondents to be brief because, to begin with, Mr. Dyson spread-eagles our interest and attention over two distinct aspects of the productivity problem: "How to measure . . ." and "How to raise . . .", each large subjects in themselves, neither of which lend themselves to effectiveness and brevity at the same time.

On the subject of "How to raise . . . ." I am impelled to cavil at Mr. Dyson's sub-title of Chart 3. To state that " . . . . payment is the *only* method that can give *any* feeling of a sense of security", is too gross. It is too gross because it is untrue: because payment is not necessarily and always the most influential factor in contriving a sense of security: because (in the present context) high pay is not necessarily congruent with high-working-pace, i.e. the personal psychodynamic factor in productivity.

Pay, *vis-à-vis* the cost of living, can, of course, be enormously important. But pay varies in importance as output incentive (or preferably disincentive) accordingly as its relation to cost of living compels it to the forefront of attention. Or, again, as other job satisfactions, such, for example, as those which minister to self-respect and sense of personal worth *vis-à-vis* other members of the work-community, pushes it into the background.

There are understandable reasons why these latter components of personal dynamic are ignored, or worse, dismissed as idealism or the enthusiastic effusions of management purists. Being understandable, therefore, they must be studied until they *are* understood and then heeded in our immediate and future management techniques.

If management persists in ignoring personal dynamic, it will persist in ignoring perhaps the most powerful of the few remaining but dwindling resources left to Britain in her striving with global economy. Mr. Dyson himself doubts whether "any new far-reaching . . . techniques . . . at present unknown . . . will be evolved to revolutionise productivity in British industry, in the next five years". Other narrowing influences on our import and export prospects, are the effects upon available world resources in raw materials of the declared productivity targets of the U.S.A., and the effect upon product costs and prices of the industrial development and recovery of the economically backward and depressed areas of the globe. We have to face the unpleasant fact that Britain's resources are narrowing down to the stratum—relatively rich, it is true—of inventive genius in her people, a few indigenous raw materials which she perilously exports under the economic compulsion of exchange for present sustenance, and the relatively unknown, unplumbed capacity, pace and ingenuity of the British people at work.

This last resource remains as yet untapped for the reason that as a dynamic it is hardly suspected and therefore almost totally ignored. When at last, and global conditions are compelling that "last" to be soon, if not now: when at last appropriate attention is given to the study, understanding and employment for productivity of the conditions which excite people to their greatest endeavours, the effects upon management techniques will be as revolutionary as anything yet witnessed in productive technology.

Social Demand and Productivity

A factor which seems to find little or no place in our productivity discussions is the influence of "potent market magnitude" better known, perhaps as "social demand for the product". This bears directly upon "ordering quantity" and consequent elaboration of planning, mechanising, tooling and so forth. If the rate of manufacture exceeds the rate of consumption, storage oncost begins to counter the economic gain implicit in "Wright's exponential law" quoted by Professor J. V. Connolly. During the War Mr. John Loxham was directing attention in the Eastern Region to the differential calculation of economic manufacturing minima which, in effect, precalculated the quantities where the exponential gain is counterbalanced by storage oncost. The quantities thus obtained were, naturally, the most economic quantities to manufacture at a time. There is a salutary lesson in this technique for those with an unqualified belief in inflated production rate unrelated to consumption rate.

Now, on the subject of "How to measure . . . . . ". It is disappointing after four years of study by the Joint Committee, and many others, that we haven't yet evolved a universal standard for the measurement and comparison of productivity. The difficulty is that we are as sharply aware today of the inappropriateness of trying to compare ingot-tons with

* January, 1953, Journal.

foot-runs or square-yards of strip-milling, as on the day at infant school the same stupendous truth about apples and pears was forced through our incredulity. But in Production Engineering and Cost Accounting we nevertheless seem to have entirely forgotten that Index Numbers were invented as common denominators for just such situations as these. Targets are very well in their way; but unless and until machine tool and process plant manufacturers are able and willing to guarantee the "theoretical capacity" of their products so that "utilisation ratios" are valid for comparison between processes; between plants; between industries; between nations, targets must be based upon known performance. It is precisely the same with Index Numbers, which can be set up without the super-preparation of Work Study.

I am not objecting to Work Study—on the contrary. But Work Study belongs to "How to raise . . . .", not "How to measure . . . .". Moreover, we shall never see "theoretical capacity", either set up or guaranteed for two reasons; (i) because of the Work Study Engineer's maxim "There is always a better method" and (ii) because of "the great complications" introduced by "the profound effect of quantity . . . . " stressed by Professor Connolly.

May I, therefore, strongly recommend a close study of Chapter 25 of Yule & Kendall's "Theory of Statistics", with special reference in the summary to the use of monetary units in a Vo'ume Index ? I can say, from personal experiment, that a very useful overall index of productivity can be constructed from the product of sub-index numbers for Labour Productivity, Methods Innovations, Indirect Labour, Allowance Time, Staff & Management ratios.

Mr. Dyson replies:

I appreciate Mr. Howell's comments on my paper, and I would be the first to agree with him that a quotation that read, "Payment is the only method that can give any feeling of a sense of security" would be not only too gross, but not actual fact. I would like to point out, however, that in the first place this Chart is headed, "Review of Wage Payment *Methods*" and secondly that the sub-title reads, "Monthly or Weekly Payment is the only *Method* that can give any feeling of a sense of security". Obviously this Chart deals specifically with *methods* of payment, and is not to be confused with the wider aspect of incentives.

I believe Mr. Howell would agree with me that it is an accepted fact that both weekly and monthly paid employees are more loyal and conscientious in regard to their job of work than, for instance, hourly paid employees. This, I feel, can be attributed to their sense of greater security, reflected to some considerable extent by their employer's attitude in paying them on a weekly or monthly basis.

Regarding Mr. Howell's comments on the cost of living, I can only reiterate the statement in my paper that ultimately "labour like capital tends to get what it produces. Wages are paid out of profits from production and merchandising, and cannot *permanently* remain above the point where profit ceases".

I would agree one hundred per cent. with Mr. Howell on the importance of creating and developing the personal dynamic approach ; in fact the very reason I emphasised the significance of environment and stressed the necessity of the desire for the mental satisfaction of knowing how one is progressing, was that I recognised the fundamental principles of this important facet of production management.

BRITISH STANDARDS

The following Standards have recently been issued, and may be obtained post free at the prices stated from the British Standards Institution, 24-28, Victoria Street, Westminster, London, S.W.1 :—

1098 : 1953. Jig Bushes (3/-).

1133 : Section 7 : 1952. Paper and Board Wrappers, Bags and Containers (17/6d.).

1453 : 1952. Filler Rods for Gas Welding (3/-).

1919 : 1953. Hacksaw Blades (3/6d.).

1935 : 1953. Adjustable Adaptors for Multiple Spindle Drilling Heads (2/6d.).

Issue of Journal

Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institutlon.

*Local Section Reports—**(continued from page 195)*

Mr. C. R. Whitaker presented a paper entitled, "Improvements and Their Hindrances," was very well attended.

Mr. H. Teasdale has left the Section to take up an appointment in the North of England. Mr. Teasdale was largely instrumental in bringing about the formation of the Section in 1951 and was the Senior Section representative on the Committee for the first year. The Section owes much to his wise counsel and guidance.

It was with regret that the Section learned of the death of Mr. D. Gould, Graduate, who was one of the most enthusiastic members. In February, 1952, Mr. Gould was awarded the Senior Committee Prize for the most outstanding Student in the Production Engineering Course at the Bristol College of Technology.

West Wales

The opening of the programme with a visit to the Trostre Works of the Steel Company of Wales was a tremendous success, added to by the presence of the President of the Institution, Sir Cecil Weir, and senior members of Head Office staff. Captain Leighton Davies, first Section President, in his Inaugural Address referred to the historical side of the Institution, and the tinplate industry.

The joint meetings have been particularly well attended, and illuminating glimpses of the fields of Industrial Research and Industrial Consultancy were given by Dr. R. O. Jones and Mr. S. E. March respectively.

Sir Patrick Hannon delighted all with his comprehensive survey of matters affecting higher administration.

INSTITUTION NOTES

COUNCIL ELECTIONS 1953/54
NOMINATIONS

(a) In accordance with Article 35, nominations are invited to fill six vacancies for elected members to serve on Council for 1953/54 (i.e. five members and one Associate Member).

(b) Candidates for election must be nominated in writing by three Members or Associate Members of the Institution.

(c) In addition to nominations as in (b) each Section Committee may nominate one candidate.

(d) NOMINATIONS MUST REACH THE SECRETARY AT 36 PORTMAN SQUARE, LONDON, W.1, NOT LATER THAN 15th APRIL, 1953.

N.B.—Before candidates are nominated for election, their consent should be obtained.

The retiring members of Council, who are willing to stand for re-election, and who do not need nomination, are as follows :—

N.B.—Mr. E. D. Broome, A.M.I.Prod.E., does not wish to stand for re-election.

Members :—	Attendances at Council	
	Possible	Actual
H. W. Bowen, O.B.E. ...	7	4
R. M. Buckle	7	3
R. C. Fenton	7	6
Professor T. U. Matthew ...	7	2
F. Bernard White	7	3

NORTH-EASTERN DINNER DANCE

This photograph, taken at the very successful Dinner-Dance arranged by the North-Eastern Section on 20th February, 1953, shows (left to right) Mr. C. C. Hodson (Section Hon. Secretary); Alderman McKeag, one of the principal guests; Mr. J. S. Elliott, Section President; Mr. R. W. Mann, immediate Past-President; Mr. C. S. Noble and Mr. L. Walker, both Past-Presidents of the Section; and Mr. W. F. S. Woodford, Secretary of the Institution.

NEWS OF MEMBERS

RESIGNATION OF EASTERN COUNTIES HON. SECRETARY

Owing to increasing business commitments, Mr. L. A. Childs, Associate Member, has relinquished the office of Honorary Secretary of the Eastern Counties Section, which he has held for seven years.

Mr. Childs, who is a Londoner by birth, is one of the most prominent members of the Section, and has been with Crane, Ltd., Ipswich, where he is now Chief Jig and Tool Draughtsman, since 1935. He joined the Institution in January, 1939, and has always taken a very active part in its affairs.

Mr. L. A. Childs

The Institution is very much indebted to Mr. Childs for his hard work and enthusiasm in helping to bring the Eastern Counties Section to its present high status, and is glad to know that he will still continue to serve on the Section Committee.

Mr. Child's successor as Hon. Secretary is Mr. A. B. Brook, Graduate, of Davey, Paxman & Co. Ltd., Colchester.

MEMBER'S AWARD

Dr. S. Y. Chung, Ph.D., B.Sc., Associate Member, was recently awarded the Joseph Whitworth Prize by the Institution of Mechanical Engineers for his joint paper on "Cup Drawing from a Flat Blank—Part I: Experimental Investigation; and Part II: Analytical Investigation".

Dr. Chung is the Chief Engineer of The World-Light Manufactory, Ltd., Hong Kong.

VISITOR FROM ABROAD

Mr. C. M. Kennedy, Associate Member, of the Sydney Section, is paying a business visit to England and South Africa.

Mr. Kennedy, who is a Director of W. D. Scott & Co., Management Consultants, of Sydney, has greatly assisted the work of the Institution in Australia by his lectures to the Sydney and Melbourne Sections.

MR. J. L. PARKER

Mr. J. L. Parker, Associate Member, previously Works Superintendent, has been appointed Works Manager of B.S.A. Tools Limited. Mr. Parker, who joined the Company in 1917, is a member of the Institution's Materials Handling Sub-Committee. Mr. H. D. Hughes, Associate Member, now takes over from Mr. Parker the duties of Works Superintendent.

MR. TOM N. WOOF, M.C.

Mr. Tom N. Woof, M.C., Member, a Director of Burton, Griffiths and Company Limited, has now been appointed "Sales Director" and in future will control all sales activities, both at Home and Overseas. Mr. Woof will continue to be responsible for the London Branch and Warehouse of Burton, Griffiths and Company Limited, but will operate to a much greater extent from the Head Office at Marston Green.

NEW APPOINTMENTS

Mr. W. T. Barry, Associate Member, is now Works Superintendent of Moore's Hydraulics, Port Melbourne, Australia. Until last November, Mr. Barry was Works Manager of Chiswell Wire Co., Watford.

Mr. E. J. G. Granger, Associate Member, has been appointed General Manager of The Thrissell Engineering Co. Ltd., Bristol.

Mr. Owen Harris, Associate Member, has been appointed Quality Control Technician at the Winnipeg Overhaul Base of Trans-Canada Air Lines.

Mr. P. L. Hepworth, Associate Member, is now Managing Director of Associated Engineering (N.Z.) Ltd., Panmure, Auckland, New Zealand.

Mr. C. K. Hughes, Associate Member, has left the U.K. to spend some years in New Zealand on behalf of his firm, Associated Industrial Consultants, Ltd.

Mr. F. A. Janes, Associate Member, has been appointed a Director of Burton, Griffiths and Company Limited. Mr. Janes has been associated with the B.S.A. Tools Group for twenty-nine years, for the last six years as Sales Manager.

Mr. F. Mountifield, Associate Member, is now Works Manager of Rodd Engineering Co. (1950) Ltd., Walton-on-Thames.

Mr. E. J. Newman, Associate Member, is now Works Manager of Deltec Ltd., Toronto, Ontario.

Mr. W. H. Shilling, Associate Member, has been appointed Budget Controller with Davey Paxman & Co. Ltd., Colchester.

Mr. S. A. Warwick, Associate Member, has been appointed Works Manager of his Company, De Grave Short & Co. Ltd., London, where he previously held the position of Chief Draughtsman & Planning Engineer.

Mr. R. I. Whitlock, Member, has been appointed Production Engineer with W. & T. Avery Ltd., Birmingham.

Mr. H. Clements, Graduate, is now an Experimental Engineer with The Hoffman Manufacturing Co. Ltd., Chelmsford.

Mr. J. D. Collins, Graduate, Overhaul Planning Engineer with The de Havilland Engine Co., is spending a few months in Japan, supervising the organisation of a firm recently appointed as the de Havilland Overhaul Agents for piston engines.

Mr. J. D. Parson, Graduate, is now Manufacturing Methods and Planning Engineer with Fortiphone, Ltd., London.

Mr. A. W. Pocock, Graduate, is now employed as Internal Combustion Engineer with Apex (Trinidad) Oilfield, Ltd., Trinidad, B.W.I.

Mr. James A. P. Ross, Graduate, has joined Euclid (Great Britain) Ltd., Newhouse, Lanarkshire, as Industrial Engineering Assistant (Methods).

Mr. L. G. Smith, Graduate, has been appointed an Engineer T.G.1. in the Directorate of Electronics Production (Air), Ministry of Supply.

HAZLETON MEMORIAL LIBRARY

Members are asked to note that the Library will be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week. Due to Meetings, the full facilities will not be available at the following times during this month:—

Thursday, 9th April all day. Thursday, 23rd April all day.
Tuesday, 28th April from midday.

It would be helpful if, in addition to the title, the author's name and the classification number could be quoted when ordering books.

REVIEW

518 SPECIAL METHODS OF CALCULATION

"The Slide Rule as an Aid in Calculating" by A. T. J. Kersey. *7th ed. London., Spon,* 1952. 124 *pages.* 10s. 6d.

This is the seventh edition of this small compendious classic on the engineer's third hand, viz. the slide rule. It will be useful revision to all who reach for a slide rule by instinct.

The 120 pages plus index are split into 11 chapters with an appended set of simple mathematical tables.

The opening paragraph of Chapter 1 contains the words "It should be borne in mind that in nearly all practical calculations we wish to approximate to a correct answer, and the skill of the operator is often best shown by approximating to the right degree of accuracy". This is the keynote of the layout of the text of the work.

A useful revision of contracted arithmetical processes and logarithms leads to Chapter 3 where the mechanics of scales is discussed together with their fundamental application to powers of the first order.

Squares, cubes and roots are shown firstly as process motions, then applied to actual calculations, e.g. spherical volume. The 3-etched line cursor is carefully described. The work in Chapter 6 on reduction and conversion contains some very useful constants such as the "c" value of weight/ft ^{3} calculations using area in ^{2} x length in ft. and examples of the slide rule in the wage, interest payment, % determinations.

A chapter on the use of the "back" scales will be revealing to any user whose trigonometry ratios have still to be found from tables, and the fractional indice is explained as a slide rule process.

Chapter 10 deals with the less common slide rules and calculators in terms of *how* to use them and is a gem of clarity of exposition on a very necessary subject. Perry's Log-Log Scale and the negative indice, the reciprocal scales on P.I.C. rules, the very accurate spiral scale calculators such as Otis King and the more common watch type calculators are all dealt with.

The closing examples of typical work likely to be met are fair and quite representative of student work if not of the more mature workers' needs. K.R.A.

ABSTRACTS

338.9 PRODUCTIVITY

"Industrial Relations Research Association, *Madison, Wis.* Industrial Productivity: A Social and Economic Analysis." *Madison, the Association,* 1951. 224 *pages.* $3.00.

This book consists of a collection of twelve papers by Americans who are authorities in their fields. Collectively, these papers represent a weighty contribution towards a full understanding of 'productivity'.

Whilst each title is treated in some detail, together they cover the subject in the broadest sense, as a sample of the titles indicates:—

The Meaning and Measurement of Productivity
Research, Technology, and Productivity
Productivity and Social Structure
Trade Union Attitudes and Their Effect Upon Productivity
An Economic Evaluation of the Gains and Costs of Technological Change
Management Techniques for Stimulating Productivity

The following is the introductory summary of the last paper, by Joseph M. Juran of N.Y. University:—

"Within a single century, the form of industry has evolved from primitive handicrafts to a very complex technology. Techniques for stimulating productivity have changed drastically in order to keep pace with the changing form of industry. Necessarily, the application of the new techniques lags behind the potentialities. Many managers are unwittingly applying, to today's problems, techniques designed to solve the problems of yesterday.

"Management techniques for productivity have to date emphasised productivity of the individual production worker. To solve the problems of tomorrow, management must not only extend these techniques to include the non-production worker; it must give far more consideration for the productivity of the enterprise as a whole.

"This new emphasis will find expression in improved co-ordination between departments, in extension of the concept of management controls, and in a planned selection and training of managers."

621.72 PATTERNMAKING

" Patternmaking ", by L. L. Cox. *Lond., Pitman,* 1952. 123 *pages, illus.* 12/6d.

This book covers all the aspects of patternmaking from the initial cutting of the rough timber for simple patterns, to the latest developments in machinery for producing complicated designs quickly and easily. Many drawings and sketches help to an easier understanding of marking out, assembling and finishing. The final chapters are devoted to photographs and descriptions of the latest wood-working machinery.

668.3 ADHESIVES

" Adhesion and Adhesives " by N. A. De Bruyne and R. Houwink, *eds. Elsevier Pub. Co.,* 1951. 517 *pages, illus., diags.* £3. 10s. 0d.

This book is a symposium on the scientific and technological aspects of adhesion. The first part covers the theoretical aspects of adhesion conditions for wetting and adhesion, together with influences of thickness and adsorbtion are discussed. One chapter deals with the molecular forces affecting adhesion. Rheological aspects of the joining of the parts is considered. Account is given of theoretical and experimental investigation into joints.

The second part includes technological aspects of adhesives and adhesion, divided into five sections—Physical testing of joints and materials; soldered joints; rubber based adhesives; silicates and inorganic cements; and organic adhesives including animal and vegetable glue, synthetic resins, and asphalic bitumen.

In most cases examples of use are given, in particular the uses of silicate adhesives and vegetable adhesives in high speed wrapping and board making machinery are mentioned. There are many references, diagrams and graphs.

623.451 PROJECTILES

" Development of The Guided Missile " by Kenneth W. Gatland. *Flight, London,* 1952. 133 *pages. Illustrated. Diagrams.* 10s. 6d.

The author has had published the substance of the book in articles in the technical press and he deals with the differing aspects of guided missiles from the ordinary rocket to spaceships. Owing to the strict security silence imposed by the Ministry of Supply he has not been able to discuss any specific British development and the book therefore covers the advanced German development up to the end of World War II and the American development as far as is known at the present time.

The author refers to the possibilities of rocket attack with atomic war-heads upon this island and the American continent, and how this new type of armament will revolutionise air to air and ground-air combats.

The problems in the design of the supersonic rocket are explained, together with their bearing on high altitude research. In this field various types of step rockets which attain heights of 200 miles and more with research equipment are analysed.

A recent photograph of the Hazleton Memorial Library at 36, Portman Square, London, W.1. The Librarian, Miss P. L. Cooper, B.A., A.L.A., is shown dealing with a member's enquiry.

With Space-Satellite Vehicles the "orbital" technique with rockets is discussed, where rockets will be fired far enough away from the earth's surface, so that they will continue orbiting the earth until radio control brings them back into the atmosphere. From the research data gained from these flights, interplanetary flight will be made possible.

In the Appendix in table form information is given on 90 powered missiles.

658.54 TIME AND MOTION STUDY

"Productivity and Probability—A Treatise on Time Study and The Improvement of Industrial Efficiency" by T. F. O'Connor. *Manchester, Emmott & Co.*, 1952. 193 *pages.* 5s.

(*Mechanical World* Monographs.)

The first 80 pages of the book are devoted to a discussion of Time Study as applied to manual work and to a comprehensive mathematical treatment of the fundamentals of bonus schemes. Formulæ are derived for all the usual methods of bonus payment and the effects of these schemes on bonus earnings are also shown graphically.

The second section (pages 80—126) is concerned with the application of Time Study to machine controlled work, where special problems arise due to the semi—or fully—automatic nature of the cycles, and to the allocation of several machines, as a group, to an operator. Various methods of making allowances for the operator's "enforced" idle time and the affect of these on bonus opportunity are also discussed.

In the third section (pages 126—178) the author considers, in some detail, the special features of Multiple Machine Working. The important effect of "interference" between the machines is pointed out, and the impossibility of determining its extent accurately by time studies on operatives of different performances, leads to a conclusion that a solution on a statistical basis gives a practical answer. A Table of Ashcroft Numbers, based on the laws of chance, is given from which the effect of interference may be computed for up to twenty machines in a group. A chart is also included, showing the number of observations of the work elements which are required to ensure accuracy within specified limits.

In the final section the author states, in general terms, the reasons why the use of Time Study as a management technique is justified.

621.357 ELECTRO-DEPOSITION : ELECTRO-PLATING

"Electroplating and the Engineer" by Alan Whittaker. *Manchester, Emmott & Co. Ltd.*, 1951. 87 *pages. Illustrated.* 4s.

(*Mechanical World* Monographs.)

Here is a book which introduces the engineer to all the particular branches of electro-deposition in an easily understood manner.

The pre-treatment, deposition and final polishing of many materials which require the more common types of plating are dealt with. Valuable information is given as to the causes of the more common faults, pitting, etc., and their removal.

The text is amplified with diagrams of plant layouts and a table giving the applications and characteristics of different finishes.

PAPERS RECEIVED

1932: **"A Recent Advance in Plastics"** by E. M. Elliott.

1938: **"The Urgency of Simplification in Production"** by T. H. Windibank.

1939: **"W.1400 Dragline"** by C. McL. Cameron.

1940: **"Preventive Maintenance"** by O. F. Lewis.

OTHER ADDITIONS

621.43 INTERNAL COMBUSTION ENGINES

Shell Petroleum Co. Ltd. **"Lubrication of Oil Engines."** *London, The Company.* 1952. 147 *pages. Illustrated. Diagrams.*

621.7 WORKSHOP PRACTICE; PRODUCTION METHODS

Engineering Production Convention, Sydney, 1951. **"Proceedings."** *Sydney, Institution of Engineers Australia, Sydney Div.* 1952. 157 *pages. Illustrated. Diagrams. Portraits.*

621.74 FOUNDRY WORK

British Zinc and Aluminium Die Casting Productivity Team. **"Zinc and Aluminium Die Casting: Report of a Productivity Team which visited the U.S.A. in 1951."** *London, Anglo-American Council on Productivity.* 1952. 98 *pages. Illustrated. Diagrams.* 4/-. (Productivity Team Report.)

621.778 WIRE DRAWING AND PROCESSING

Timaeus, C. E. **"Century and A Half of Wire Weaving: The Story of C. H. Johnson and Sons Ltd."** *London, Newman Neame Ltd. for C. H. Johnson.* 1952. 56 *pages. Illustrated.*

621.791 WELDING; CUTTING

British Welding Research Association, London. **"Memorandum on Non-Destructive Methods for the Examination of Welds."** *London, The Assoc.* 1952. 63 *pages. Illustrated. Diagrams.* 5/-.

Eutectic Welding Alloys Corporation, New York. **"Tool and Die Salvage Manual."** *New York, The Corporation.* 1952. 63 *pages. Illustrated. Diagrams.*

621.795 SURFACE PROCESSES; FINISHING

Oxenbury, R. W. **"Metal Finishing Processes and Their Fire Hazards."** *London, Chartered Insurance Institute.* 1951. pp. 127-162. 2/-. (Chartered Insurance Institute Journal, Vol. 49.)

621.822 BEARINGS

Willi, Albert B. **"Handbook of Sleeve Bearings."** *Detroit, Federal-Mogul Corp.* 1941. 250 *pages. Illustrated. Diagrams.*

621.83 GEARS

Fellows Gear Shaper Co., Springfield, Vt. **"The Involute Curve and Involute Gearing."** (6th Ed.) *Springfield, The Company.* 1952. 87 *pages. Diagrams.*

621.852 BELTING

Fenner, J. H. & Co. Ltd., Hull. **"Fenner V-belt Drives."** *Hull, The Company.* 1952. 80 *pages. Illustrated. Diagrams.*

621.882 SCREWS; NUTS; BOLTS

Industrial Fasteners Institute, Cleveland, Ohio.—Locknut Section. **"Description and Principle of Operation of Representative Types of Locknuts."** *Cleveland, The Institute.* 1952. 23 *pages. Illustrated. Diagrams.*

621.888 SPRINGS

Wahl, A. M. **"Mechanical Springs."** *Cleveland, Penton Pub. Co.* 1949. 435 *pages. Illustrated. Diagrams.* £2 8s. (Machine Design Series.)

621.9 MACHINE TOOLS; MACHINING

Carpenter Steel Co., Reading, Pa. **"Notebook on Machining Stainless Steels."** *Reading, The Company.* 1951. 100 *pages. Illustrated. Diagrams.* 50c.

Protolite Ltd., London. **"Machining of Rarer Metals."** *London, The Firm.* 1952. 14 *pages. Illustrated. Diagrams.*

Vacuum Oil Company Ltd., London. **"Hydraulic Systems and Hydraulic Oils for Machine Tools."** *London, The Company.* 1952. 59 *pages. Illustrated.* (Vacuum Technical Series No. 4.)

621.919 REAMING; BROACHING

Burden, W. Wilson. **"Broaches and Broaching."** *New York, Broaching Tool Inst.* 1944. 97 *pages. Illustrated. Diagrams.* $3.00.

Lapointe Machine Tool Co., Hudson, Mass. **"Lapointe Broaches and Broaching Machines."** *Hudson, The Company.* 1944. 108 *pages. Illustrated. Diagrams.*

621.92 GRINDING

Norton Company, Worcester, Mass. **"The ABC of Surface Grinding."** *Worcester, The Company.* 1952. 88 *pages. Illustrated.*

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SECTION HONORARY SECRETARIES

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Adelaide (South Australia) ...	W. Hemer, 6, Bedford Street, Brooklyn Park, South Australia.
Melbourne (Victoria, Australia) ...	R. W. Deutsher, W. A. Deutsher (Pty.) Ltd., 374/80, Point Nepean Road, Brighton, S.6, Victoria, Australia.
Sydney (N.S.Wales)	J. B. Finlay, Room 802, 16, Barrack Street, Sydney, Australia.

CANADA

Canada	T. H. Beard, 144, Glendale Avenue, Toronto.

INDIA

Bombay	M. W. Hall (Acting), I.Prod.E., c/o National Machinery Manufacturers Ltd., Kalwe, Thana, Bombay, India.
Calcutta	J. Warren-Boulton, c/o Machine Tools (India) Ltd., Stephen House, Dalhousie Square, Calcutta.

NEW ZEALAND

New Zealand	H. R. Holmes, Pah Road, Papatoetoe, Auckland.

SOUTH AFRICA

South Africa	The Secretaries, Institution of Production Engineers, Barclays Bank Buildings, Corner Commissioner and Harrison Streets, Johannesburg.

UNITED KINGDOM

Birmingham	A. J. Mansell, 204, Alcester Road South, Birmingham 14.
Cornwall	F. G. Hawke, 17, Church Road, Pool, Redruth, Cornwall.
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Eastern Counties	A. B. Brook, Davey Paxman & Co. Ltd., Britannia Works, Colchester.
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Lincoln	H. Wright, 101, Longdales Road, Lincoln.
Liverpool	L. C. Jarman, 17, Cambridge Road, Prenton, Birkenhead.
London	R. Hutcheson, Machine Shop Magazine, Dorset House, Stamford Street, London, S.E.1.
Luton	J. F. W. Galyer, Engineering Dept., Luton & South Beds., College of Further Education, Park Square, Luton.
Manchester	R. S. Clark, 13, Fownhope Road, Ashton-on-Mersey, Sale, Cheshire.
North Eastern	C. C. Hodson, Alfred Herbert Ltd., Carliol Square, Newcastle-upon-Tyne.
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Nottingham	C. N. T. Manfull, Chellaston House, Thurgarton Street, Nottingham.
Oxford Sub-Section	M. J. Inston, 53, Rymers Lane, Cowley, Oxford.
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Sheffield	E. Levesley, The English Steel Corporation, Ltd., Sheffield.
Shrewsbury Section	J. A. Francis, "Meole Meads," Bank Drive, Longden Road, Shrewsbury.
Southern	J. W. Taylor, 44, Deacon Road, Bitterne, Southampton.
S. Essex Sub-Section	P. H. W. Everitt, 6, Hillcrest Road, Loughton, Essex.
South Wales and Mon.	W. D. Porter, 49, Kyle Avenue, Rhiwbina, Cardiff.
Stoke-on-Trent Sub-Section ..	R. Rowley, North Staffordshire Technical College, Stoke-on-Trent.
Western	A. Eustace, 19, Ferndale Road, Northville, Bristol, 7.
West Wales Section	H. P. Sanderson, I.C.I. Ltd. (Metals Division), Waunarlwydd, Nr. Swansea.
Wolverhampton	W. J. Marshall, Central View, Norton-in-Hales, Market Drayton, Shropshire.
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J. Merkine, 45, Arlozoroff Street, Ramat-Gan, Israel.

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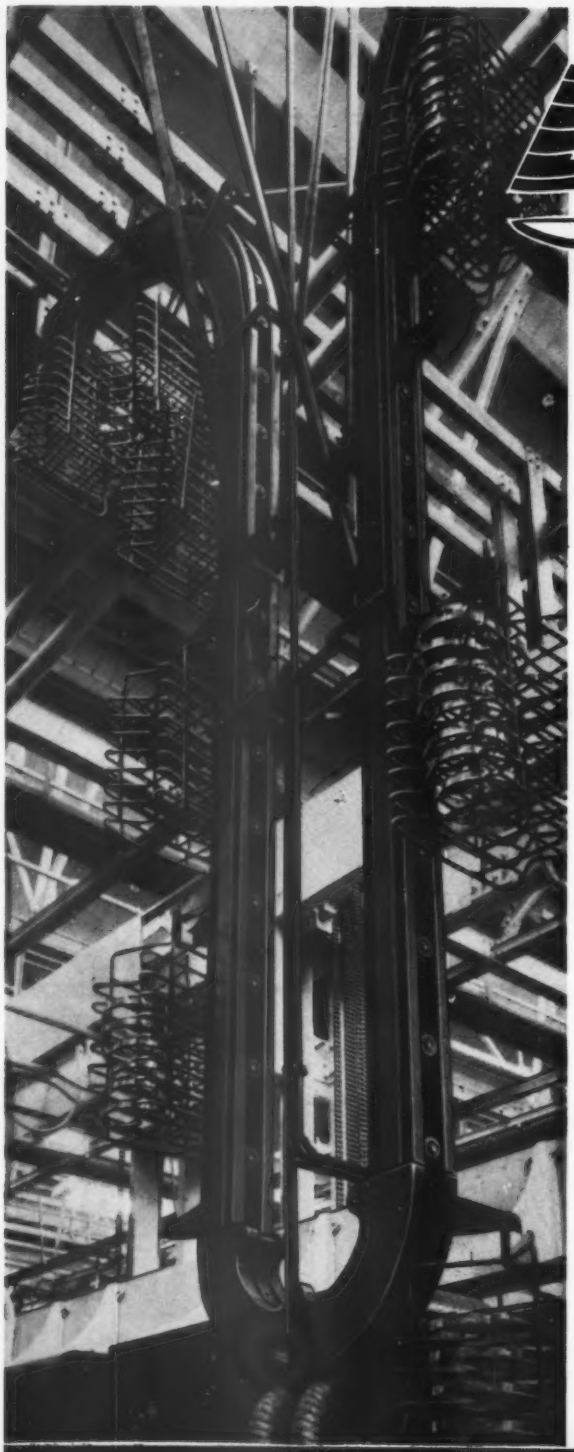

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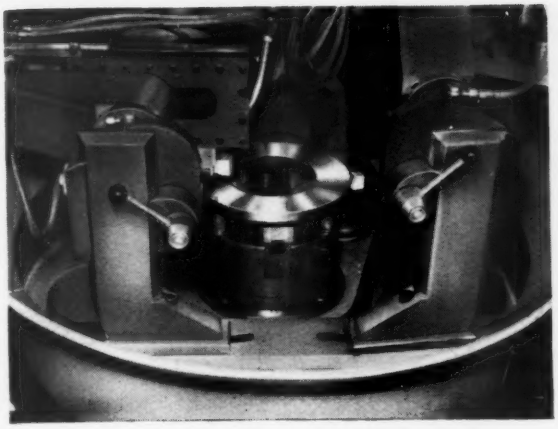

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The Vertimax can be adapted to many purposes where two simultaneous operations are required.

. . . **steel pipe flange** has a diameter of 11" and a face width of $2\frac{1}{2}$". It was machined on the face and the outside diameter turned in $1\frac{1}{2}$ minutes on the Vertimax Twin Slide Vertical Chucking Lathe.

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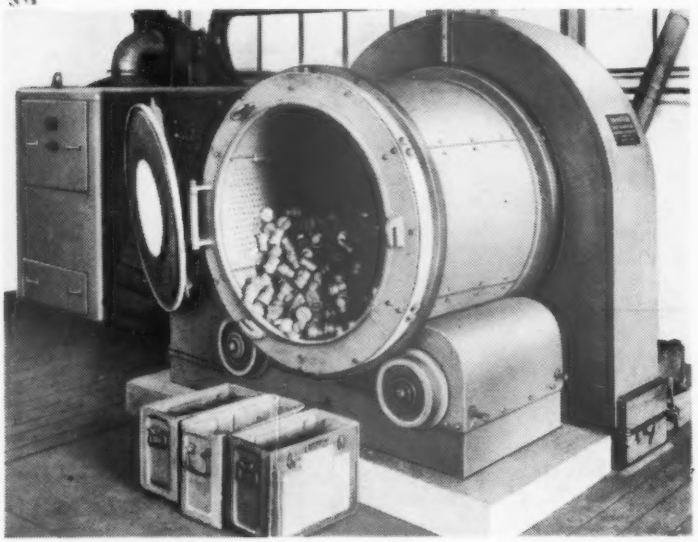

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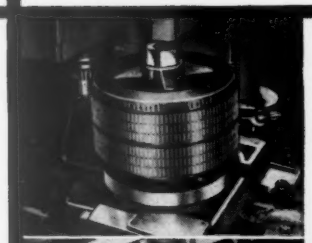

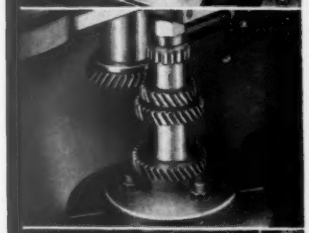

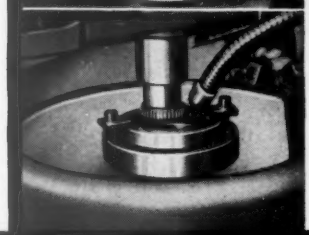

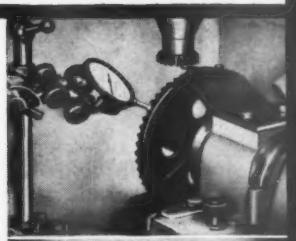

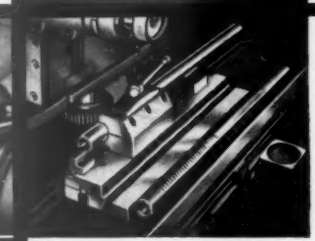

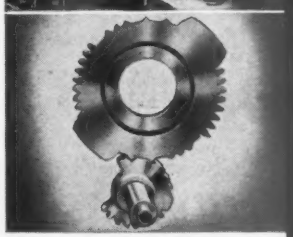

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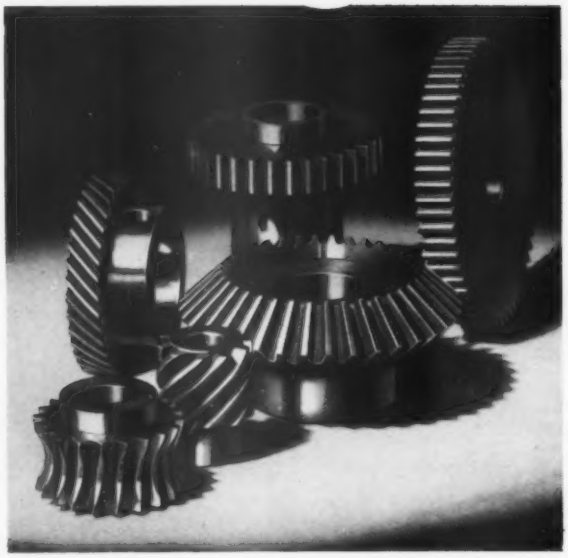

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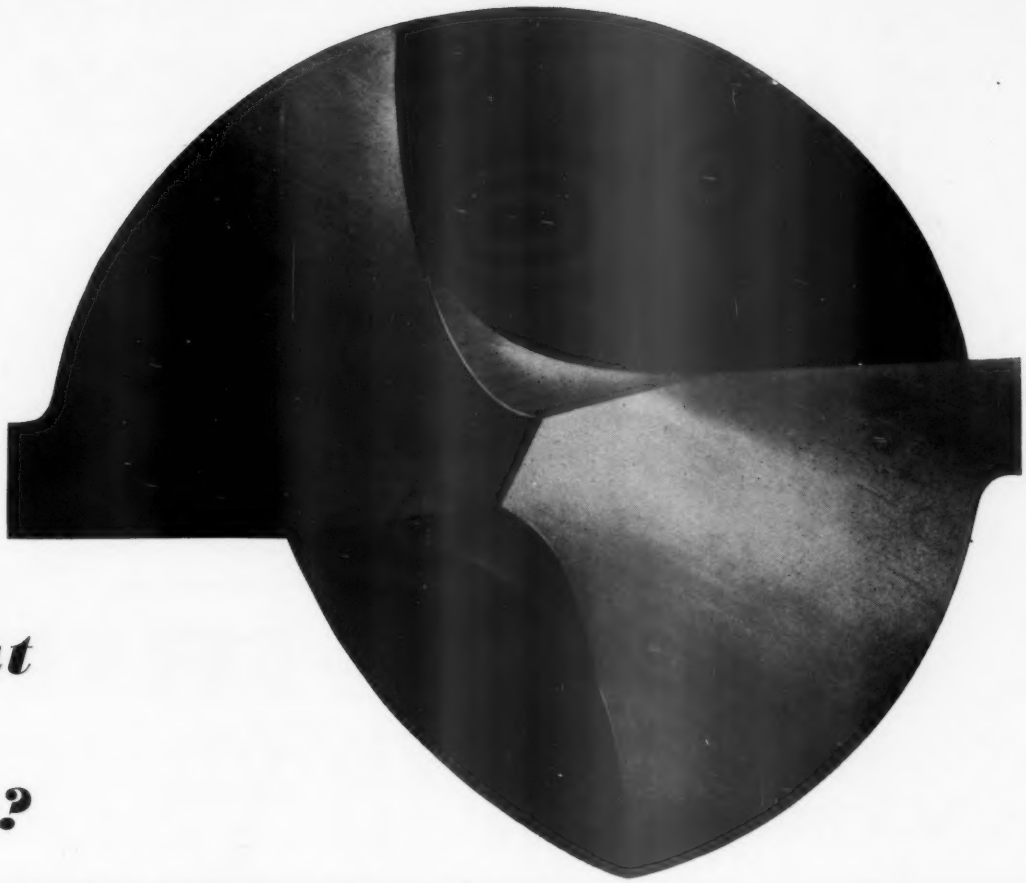

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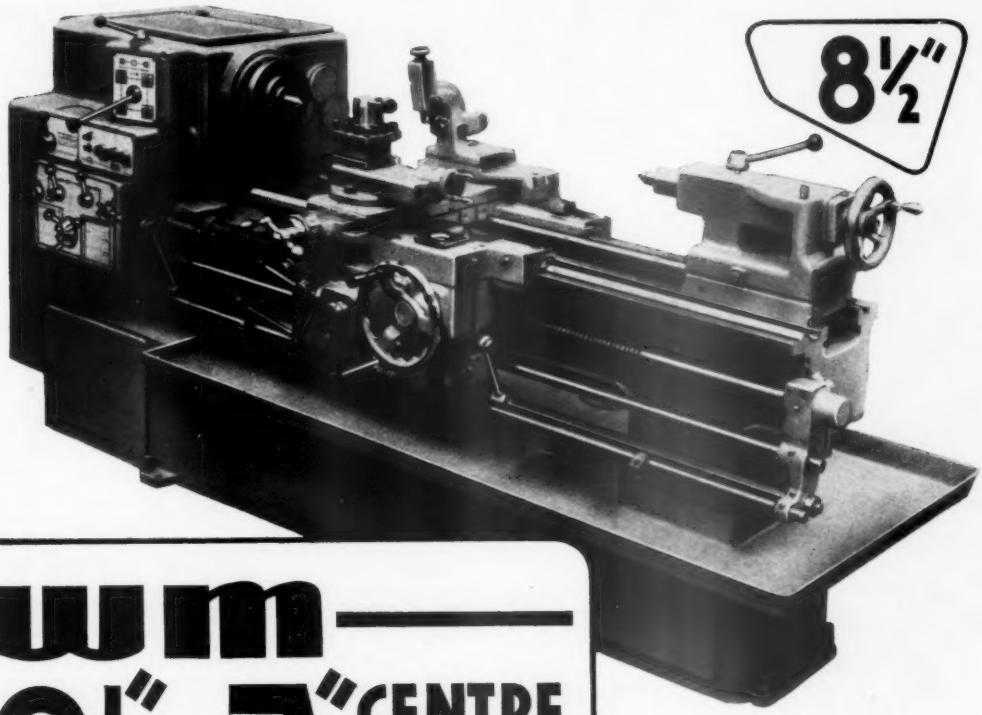
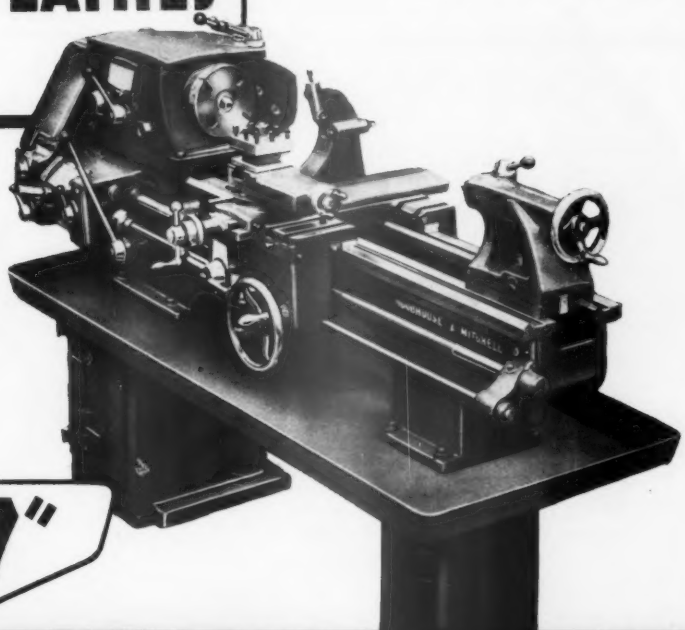


WM— 8½" & 7" CENTRE LATHES

Above: the WM. "85" 8½in. S.S. and Sc. Lathe with 8ft. bed to admit 48-in.



To-day's heavier production demands the utmost reliability in every machine tool installed in your workshops. Both these W. & M. Lathes are designed and built for just that arduous service—for accuracy, ease of operation and thorough dependability year in and year out. Write for descriptive booklets.

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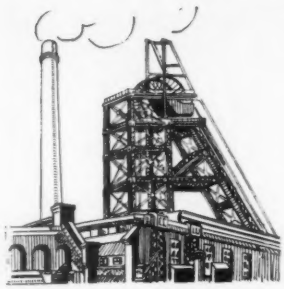

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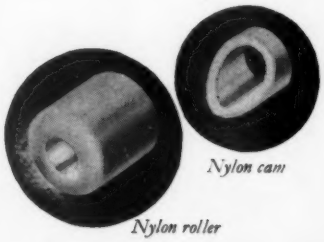

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Nylon roller

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the plastics people

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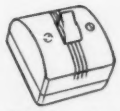
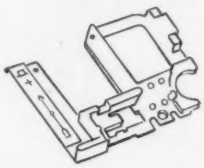


Phenolic switch



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Polyethylene bottle

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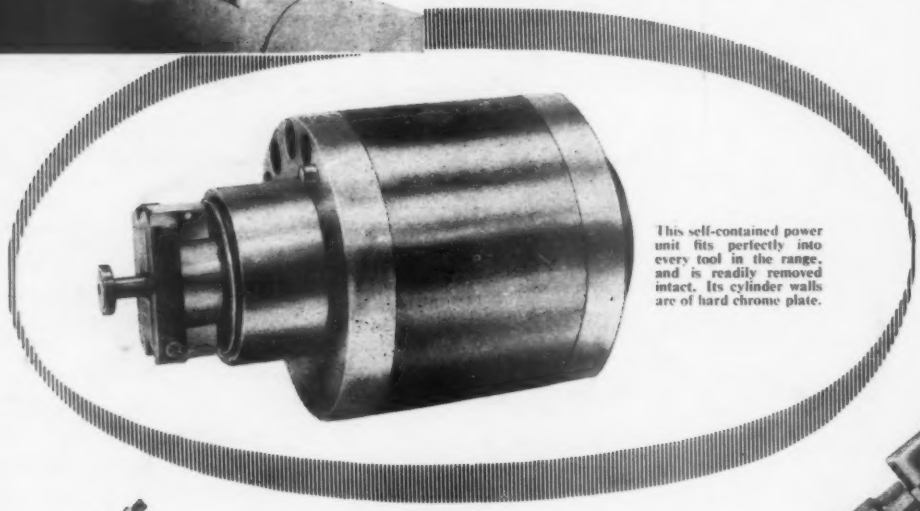
Completely self-contained, *interchangeable* motors make Holman Rotodrills and Rotogrinds exceptionally convenient and efficient in operation as well as unusually low in maintenance costs. Their power-weight ratio is appreciably higher than any other tools of equal capacity, and every tool in the range is a smooth-running, well-balanced machine with all the dependability associated with Holman Pneumatic Tools.



This self-contained power unit fits perfectly into every tool in the range, and is readily removed intact. Its cylinder walls are of hard chrome plate.

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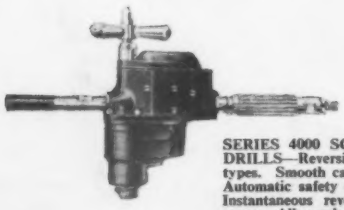

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